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Redacted for Privacy

Abstract approved: _____
Stanley V. Gregory

Microhabitat distributions and abundances of the limnephilid caddisfly Dicosmoecus gilvipes and co-occurring lotic herbivores were determined by counting grazers in complete belt transects across a 50-m reach of a coastal Oregon stream. Early-instar Dicosmoecus gilvipes occurred at stream margins; third-instar larvae began migrating into mid-channel sites. Fourth- and fifth-instar larvae aggregated in swift (0.34 m/s), deep (38 cm) mid-channel patches. Selection for mid-channel bedrock and small boulder macrohabitats was mediated by caddisfly mobility. The snails Juga silicula and Lithoglyphus virens were distributed in a broader range of microhabitats than were D. gilvipes; these snails were generally at velocities lower than average stream velocities (J. silicula: 0.12 m/s; L. virens: 0.13 m/s) and did not select for particular substrates.

Behavioral catalogs developed for D. gilvipes and J. silicula provided a context for interpreting behavior under varying conditions. Third instar D. gilvipes fed more often on diatoms than on filamentous green algae, and were often crawling during laboratory observations. Fourth- and fifth-instar larvae fed more readily on filamentous algae and crawled more quickly than third-instar larvae. Juga silicula moved more quickly on diatoms than on filamentous algae.

Foraging strategies were constrained by limitations of life history and consumer morphology. When J. silicula and D. gilvipes behaviors were analyzed using time-lapse photography during a 31-day laboratory experiment, these herbivores shifted from seaching wide ranging areas to more restricted patches in response to algal depletion; mayflies increased drifting frequency to expand their search range.

Behavior observed in the laboratory and in field studies revealed species-specific foraging responses to hunger, algal physiognomies, and habitat. Intrinsic characteristics of the biota and extrinsic factors in streams change seasonally, and result in temporal variations in foraging strategies. Variability in developmental stage, mobility, algal preferences, and substrate preferences contribute to differences in distribution patterns among D. gilvipes and co-occurring herbivores, and potentially provide mechanisms for partitioning the algal resource.

Foraging Behavior of the Limnephilid Caddisfly, Dicosmoecus gilvipes, and Co-occurring Herbivores in Streams of the Pacific Northwest

by

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FORAGING BEHAVIOR OF THE LIMNEPHILID CADDISFLY DICOSMOECUS GILVIPES AND CO-OCCURRING HERBIVORES IN STREAMS OF THE PACIFIC NORTHWEST

I. GENERAL INTRODUCTION

Benthic herbivore guilds comprised of several functional groups are common in the Pacific Northwest (Hawkins and Sedell 1981, Hawkins and Furnish 1987). Rasping snails, scraping caddisflies, and collecting mayflies are dominant members of these assemblages. Previous studies have established that herbivores are often more abundant in open well-lighted areas, but little is known of microdistribution within these sites (Cummins 1975, Gregory 1983, Hawkins et al. 1982). An objective of my study was to determine microdistribution patterns of co-occurring herbivores and the role of behavior in establishing those patterns.

Individual taxa have been the focus of foraging behavior studies among stream invertebrates (Hart 1981, Kohler 1983, Wiley and Kohler 1980). There have not been any comparative studies on foraging lotic invertebrates despite strong interest in predator-prey and territorial interactions (Peckarsky and Dodson 1980, Hildrew and Townsend 1979, McAuliffe 1985). In my study foraging behaviors of two invertebrate grazers, the limnephilid caddisfly, Dicosmoecus gilvipes and the pleurocerid snail, Juga silicula, were compared under stream and laboratory conditions. A third common grazer, the baetid mayfly Baetis tricaudatus was also observed in the laboratory. These grazers represent distinctly different functional groups (scrapers, raspers, and collector/gatherers respectively) that are also common in other temperate streams.

Seasonal variations were an important element in the design of experiments and observations. In holometabolus insects such as Dicosmoecus gilvipes morphology changes with each molt, and concomitant

behavioral changes are likely. Behavior of D. gilvipes instars II-V were observed during laboratory in order to establish variations in behavior occurring during larval development. Other behavioral changes also may occur on a seasonal time frame, in conjunction with a complex of physical changes including flow, temperature, and daylength. Both distribution and behavior of D. gilvipes in Big Elk Creek, OR were enumerated in Spring, 1986 to examine responses of this species to physical variations in the stream.

Behavior provides a measure of grazer response to its environment (Hazlett 1988). Responses of caddisflies and snails were observed under a range of conditions that were established in the laboratory and occurred naturally in the stream. In Chapter I of this thesis distribution and abundance of Dicosmoecus gilvipes and other macroinvertebrate herbivores at Big Elk Creek, OR were enumerated. Correlations with physical conditions were examined and behaviorial observations were made of D. gilvipes in the stream. In Chapter II behavioral changes during larval development of D. gilvipes were described. Foraging patterns and speed of movement for D. gilvipes, J. silicula, and B. tricaudatus were examined under varying algal physiognomies and abundance in Chapter III. Behavioral observations and grazer distribution patterns were combined to identify potential herbivore responses in the stream environment.

II. DISTRIBUTION AND ABUNDANCE OF CO-OCCURRING MACROINVERTEBRATE HERBIVORES ON A COASTAL OREGON STREAM

Abstract

Distribution, abundance, and foraging behavior of the limnephilid caddisfly, Dicosmoecus gilvipes, were studied from March through June, 1986 in a 50-m reach of Big Elk Creek, OR. Distribution patterns, determined by visual enumeration of contigous 0.25 m^2 quadrats along stream transects, were compared with those of co-occurring herbivores, Juga silicula, Lithoglyphus virens, and glossomatid caddisflies, Glossosoma penitum and Agapetus bifidus. Stream velocity and depth, distance from the bank, and substrate size were also enumerated for each quadrat. Third-, fourth-, and fifth-instar D. gilvipes were distributed on macrohabitat patches up to 6 m wide on bedrock or small boulders. First- and second-instar larvae primarily occupied stream margins. Both species of snails were found in most habitats occurring in the stream, and did not appear in distinct patches. Snails did not prefer any substrate size; Juga avoided rubble/pebble, and Lithoglyphus avoided bedrock. In late June fifth-instar D. gilvipes occurred at low velocities, and glossosmatid caddisflies occurred at highest velocities. Dicosmoecus gilvipes comprised a small proportion of total herbivore abundance; maximum abundance of these caddisflies occurred in April, prior to peak chlorophyll abundance. Other herbivore densities increased with higher chlorophyll abundances until May 29, when total herbivore numbers declined. During behavioral observations fifth-instar larvae crawled faster and more linearly than fourth-instar larvae (1.8 cm/min and 0.4 cm/min, respectively). Though caddisfly and snail distributions frequently overlapped, distinct patches of Dicosmoecus gilvipes in mid-channel small boulder or bedrock habitats, with very few other herbivores, were observed from April through early June. Factors contributing to Dicosmoecus gilvipes movement into these habitats included developmental stage and associated increased mobility, algal abundance, and changing physical constraints. Co-occurring herbivores differed in the size of contiguous patches were they occurred, substrate electivities, and seasonal movements across the stream.

Introduction

Benthic herbivores are often dominant taxa in mid-order temperatef streams where algae is abundant and canopy does not close over the stream (Vannote et al. 1980, Hawkins and Sedell 1981, Hawkins et al. 1982). The limnephilid caddisfly Dicosmoecus gilvipes is a common scraper herbivore found in western North American streams (Hauer and Stanford 1979, Wisseman 1987). In the coastal streams of Oregon, D. gilvipes often occurs among other herbivores in reaches with open riparian canopies and bedrock substrates. Interactions between food resources and this scraper caddisfly have been studied, but little is known about microhabitat preferences (Hart 1980, Hart and Resh 1981, Lamberti et al. 1987, Li and Gregory 1989, Wiggins and Richardson 1982, Wisseman 1987). Associations with other herbivores also have not been examined. Dicosmoecus gilvipes larvae and several co-occurring rasping or scraping herbivores feed on the topS of substrates, thus abundances and microhabitat use can be documented easily. Our study focused on a guild of macroinvertebrate herbivores at Big Elk Creek, OR that included Dicosmoecus gilvipes, the pleurocerid snail Juga silicula, the hydrobiid snail Lithoglyphus virens, and two glossosomatid caddisflies, Glossosoma penitum and Agapetus bifidus.

Temporal variations in the biota arise in part because of developmental changes in morphology and concomitant changes in behavior. Responses by organisms to the environmental templet will be limited by these morphological and behavioral constraints (Li and Gregory 1989). Potential responses include changing food requirements, different uses of microhabitat, and varying interspecific interactions (Anderson and Cummins 1979, Townsend 1989, Wiley and Kohler 1984). Assessment of benthic invertebrate distribution should incorporate a time frame that spans developmental changes of organisms within the community.

Stream habitats and resource abundance are distributed in a patchy pattern, and invertebrate distributions potentially reflect these patches (Pringle

et al. 1988, Townsend 1989). Physical features such as substrate, flow and turbulence vary between microhabitats, change seasonally, and directly affect habitat use (Minshall 1984, Statzner 1988). Seasonal changes in physical characteristics (e.g., light, stream flow, photoperiod, and water chemistry) affect abundances of algal resources (Gregory 1983, McIntire 1966), and herbivores are indirectly affected by temporal variations in physical factors that determine algal abundances. This study examined habitat use by herbivores over a time span sufficient to include a range of physical and biological changes.

My study examines habitat characteristics associated with Dicosmoecus gilvipes distribution and abundance during larval development, describes D. gilvipes foraging behavior as a mechanism contributing to distribution patterns, and compares D. gilvipes distribution with that of co-occurring herbivores.

Methods

Study Site

Big Elk Creek is a fourth-order stream in the Yaquina drainage of western Oregon. A map of the 50-m study site was drawn at low flow in November, 1985 (Fig. 1.1). Consecutive transects at 1-m intervals were set perpendicular to a tape stretched from one upstream corner of the 50-m section to the downstream corner on the opposite bank. Active channel, bankfull width, woody debris, boulders, and bedrock patches were measured for every transect, and drawn to scale on a planar map. The 50-m study site was subdivided into five 10-m sections for choosing sampling transects. One transect from each 10-m section was chosen randomly on most sampling days, and transects were not repeated during the season.

Data Collection

Invertebrates and physical factors were enumerated on consecutive 0.25 m^2 quadrats (0.5 m x 0.5 m) along each transect for the width of the

Figure 1.1. Map of 50-m study site at Big Elk Creek, Lincoln County, OR in November, 1985.

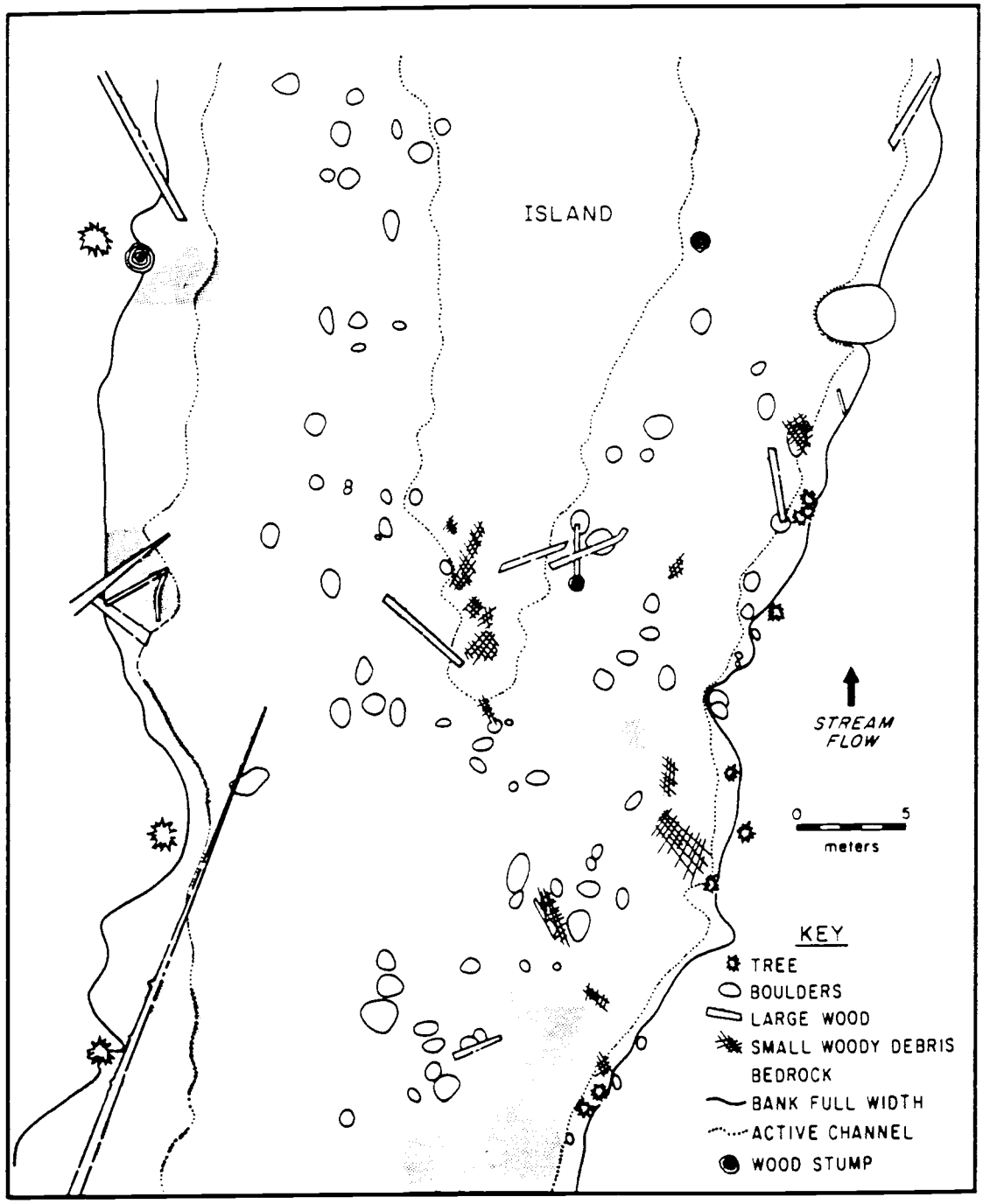

ISLAND
STREAM FLOW
0
5
meters
KEY
TREE
BOULDERS
LARGE WOOD
SMALL WOODY DEBRIS
BEDROCK
BANK FULL WIDTH
ACTIVE CHANNEL
WOOD STUMP

Figure 1.1.

wetted channel. Velocity was measured with a Montidoro-Whitney flowmeter one cm off the bottom. Depth was measured to the nearest centimeter in the center of each quadrat.

Benthic macroinvertebrates and substrates were counted by viewing consecutive 0.25 m^2 quadrats through a plexiglass viewer. This technique limited the study to easily visible scraper or rasper herbivores, and excluded smaller organisms such as mayflies or chironomid midges. Glossosoma and Agapetus were indistinguishable using our counting techniques, therefore glossosomatid caddisflies were grouped together in our enumerations. Early-instar Dicosmoecus gilvipes were enumerated in stream margins in February. Dicosmoecus gilvipes, Juga silicula, Lithoglyphus virens and glossomatid caddisflies were counted on March 20 and April 10, but high flows prevented measurements in mid-channel. All herbivores were enumerated along full transects beginning on April 22; these full-transect counts were made every two weeks through the end of June.

Substrates were classified by width according to a Phi scale to the nearest 10% of each category (Cummins 1969, Wentworth 1922). The scale used was: sand < 1cm, fine gravel = 1-2 cm, coarse gravel = 2-4 cm, pebble = 4-8 cm, rubble = 8-16 cm, cobble = 16-32 cm, small boulder = 32-64 cm, and large boulder > 64cm. Bedrock was also included as a substrate.

Five rocks were collected on each sampling date for estimating chlorophyll abundance. Rocks were soaked in 90% buffered acetone for 24 h. Extracted chlorophyll was measured with a spectrophotometer using the trichromatic method (Strickland and Parsons 1968). Exposed surface areas of rocks were measured by wrapping each rock with aluminum foil, trimming excess foil, and weighing the foil wrap. Foil weights were converted to area estimates by multiplying by area of foil/g of foil, and dividing by two to estimate exposed surface area.

Dicosmoecus larvae were collected immediately downstream from the study site to determine proportions of instars or size classes present on each

sampling date. I tried to collect 50 larvae/day, but numbers of larvae measured varied particularly on dates when D. gilvipes were uncommon. Caddisfly instars were determined by measuring distance across the eyes with a microscope micrometer in a stereomicroscope at 20x (Wiggins and Richardson 1980).

Statistical Analysis

Invertebrate abundances on different dates were compared by calculating mean numbers of each taxon for all transects on each day. These mean abundances were compared with chlorophyll abundance by regression analysis. The significance of the correlation coefficient, r, between mean herbivore densities and mean cholorophyll a abundance was tested with a t-statistic (Poole 1974). Mean abundances of each taxon associated with physical factors (e.g., velocity, depth, distance from the bank) were determined by averaging abundance only in quadrats that were occupied by that taxon and excluding quadrats where the organism did not occur.

Mean velocities and depths associated with each herbivore taxon for each transect were compared using a Friedman Chi-square or a Mann-Whitney test. These tests were chosen according to the number of transects sampled. The Mann-Whitney was appropriate for a paired sample of two transects (on April 22) and the Friedman Chi-Square tested more than two (five transects on other sampling dates).

Association of grazers with substrate sizes was analyzed with Vanderploeg and Scavia's E* index (Vanderploeg and Scavia 1979). The proportion of grazer use for each substrate was estimated as:

$$r = \sum_{j=1}^{n} g_{ij} \Big/ \sum_{i=1}^{m} \sum_{j=1}^{n} g_{ij}$$

where i = each substrate category, j = each sampling day, g_{ij} = mean number of quadrats where substrate i > 50% and occupied by a particular grazer taxon on each day, n = 7 days, and m = 8 substrate categories. Proportion of

availability for each substate was calculated as:

$$p = \sum_{j=1}^{n} s_{ij} \Big/ \sum_{i=1}^{m} \sum_{j=1}^{n} d_{ij}$$

where s_{ij} was the mean number of quadrats where substrate i occurred in the stream. Vanderploeg and Scavia's selectivity coefficient was calculated as :

$$Wi = r_i / p_i \Big/ \sum_{i} r_i/p_i$$

The electivity index, $E^* = [W_i - (1/n)]/[W_i + (1/n)]$ was a function of the number of substrates (8) and ranged between plus one and minus one. Electivity indices >0.1500 were considered as indicators of preference, $E^* < -0.1500$ indicated avoidance.

Dicosmoecus abundances for each 0.25 m^2 quadrat were summarized in a frequency distribution for each instar. The shape of each distribution was tested for agreement with random and contagious distributions (Elliott 1979).

Another way of describing herbivore distribution patterns was to examine instances of contiguous distribution on each sampling day; adjacent quadrats occupied by a particular taxon were considered contiguous. A "patch" was defined as an area where that taxon occupied more than two contiguous quadrats (i.e., a width > 1 m).

Detrended correspondence analysis (DCA) was used to compare abundances of Dicosmoecus instars with other herbivores, and to examine patterns related to physical variables among sites where taxa were present (Hill 1981). Samples taken on April 22, May 14, and June 16 were chosen for DCA analysis because different instars of Dicosmoecus were numerically dominant on each of these dates. Abundances for each taxon, stream depth, velocity, distance to the nearest bank, and dominant substrate in phi units for each 0.25 m^2 were used in this analysis. To examine the relationship between species abundances and physical variables, Pearson's correlation coefficients were calculated between quadrat ordination scores on the first and second axes and

corresponding values for each physical variable.

Behavioral Observations

Behavioral observations of Dicosmoecus were made in March and May at sites downstream from the study site. Activities were categorized according to a behavioral catalog previously developed (Li and Gregory 1989). Numbers of feeding, resting, crawling, case building and interacting activities were recorded for each individual. Interactions included aggressive movement between individual Dicosmoecus, larvae that crawled over one another, or larvae that clung to cases of other larvae. Differences in the proportion of time spent by each instar in these behaviors were compared with a G-test (Sokal and Rohlf 1981).

Crawling patterns were recorded as "linear" if larvae moved in a straight line, "zig-zag" when larvae frequently turned approximately 45^{O}, and "patchy" if larvae tended to move in a circular path. A G-test for heterogeneity (Sokal and Rohlf 1981) was used to test for differences in crawling patterns among instar larvae.

Movements of individuals observed at 5-min intervals during periods ranging fom 30-120 min were mapped. Distances that larvae travelled and angles turned were digitized from map drawings. Differences in speed among instars were analyzed with a Kolmolgorov-Smirnov Two Sample test (Sokal and Rohlf 1981). Comparison of angles turned by different instars was made by a G-statistic goodness-of-fit test.

Results

Changing Stream Environment

Stream discharge decreased from winter to early summer (Table 1.1). High discharge in March prevented measurement of complete transects. High flows continued in April, followed by steady rains during the first two weeks of May. Flows decreased in late May, reducing available wetted channel area (Table 1.1). As depths decreased, more substrates became exposed.

Table 1.1. Mean depth, flow, area and discharge at Big Elk Creek study site during spring and early summer, 1986. Numbers in parentheses are standard deviations.

Date	Mean Depth (cm)	Mean Velocity (m/s)	Mean Area (m^2)	Mean Discharge m^3/s
20 Mar*	35 (15)	0.19 (0.27)	n.a.	n..a.
10 April*	22 (12)	0.20 (0.24)	n.a.	n.a.
22 April	39 (17)	0.17 (0.16)	9.14	1.50
14 May	37 (14)	0.14 (0.18)	7.91	1.18
28 May	24 (11)	0.16 (0.22)	3.75	0.61
16 June	25 (11)	0.10 (0.12)	3.88	0.48
30 June	21 (13)	0.13 (0.20)	3.28	0.35

*: Partial Transects

Bedrock was the most available substrate during the sampling season; small boulder, cobble, and sand were also common (Fig. 1.2).

Dicosmoecus Abundance and Distribution

Dicosmoecus gilvipes were most numerous in early April (10.2/m^2) when third instars were dominant (Fig. 1.3, Table 1.2). Numbers of larvae decreased as the cohort developed. Third-, fourth-, and fifth-instar larvae co-occurred in mid-May. Fifth-instar larvae were never as abundant as earlier-instar larvae. Abundance decreased rapidly between May 29 and June 17.

Dicosmoecus moved from stream edges into the thalweg, or main stream channel, as larvae developed. First- and second-instar larvae occupied low velocity margins (Table 1.3). These early-instar larvae inhabited moss and grassy sites at very shallow depths in February (mean depth = 2.6 cm), and moved to slightly deeper water by March 4 (mean depth = 12.6 cm). By April 22, larvae occupied a variety of habitats with third-instar larvae in shallower water (mean depth = 28 cm, mean velocity = 16 cm/s) and fourth-instar larvae in significantly deeper, swifter waters (mean depth = 38 cm, mean velocity = 0.34 m/s)($p < 0.001$ Friedman test)(Table 1.3). Third-instar larvae continued to occupy shallower, lower velocity habitats on May 14 in comparison to fourth- and fifth-instar larvae ($p < 0.10$, Friedman test). Fourth- and fifth-instar larvae occupied habitats with similar depths and velocities (Table 1.3). The number of individuals in each transect for each instar were insufficient for statistical testing in late May and June.

Changes in D. gilvipes development coincided with changes in stream depths and velocities occupied by third-, fourth- and fifth-instar larvae (Figs. 1.4, 1.5). The majority of quadrats with third-instar larvae were less than 30 cm deep (Fig. 1.4). Occassionally third-instar larvae were abundant at velocities greater than 40 cm/s, probably reflecting the swifter stream flows in March. A high proportion of fourth- and fifth-instar larvae occupied habitats with velocities more than 20 cm/s, whereas the majority of available stream velocities were lower (Fig. 1.5).

Figure 1.2. Percent of quadrats dominated by different sediment size classes in Big Elk Creek, based on cumulative sums for 8 sampling dates between March 20 and June 30, 1986.

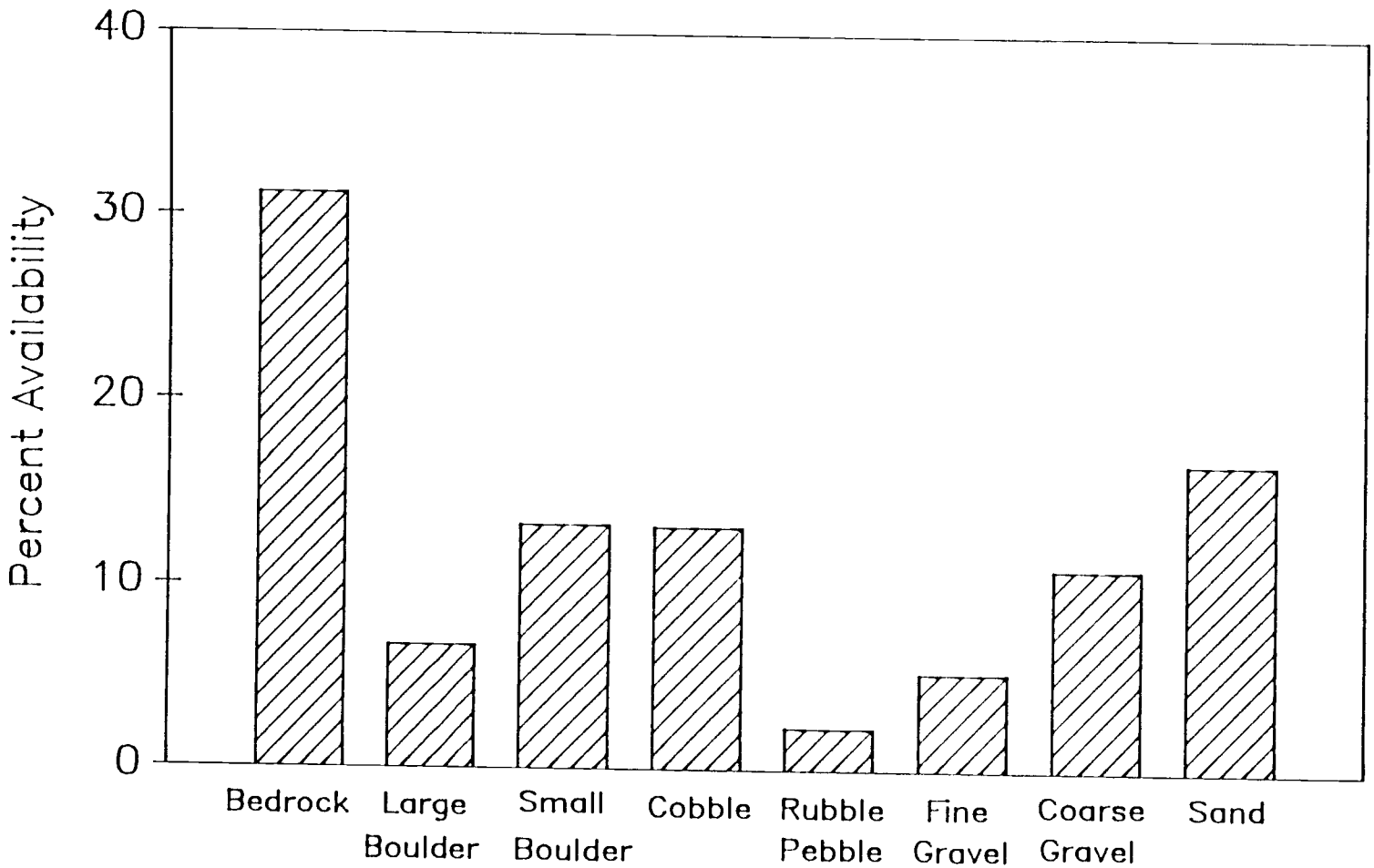

Percent Availability
40
30
20
10
0
Bedrock
Large Boulder
Small Boulder
Cobble
Rubble Pebble
Fine Gravel
Coarse Gravel
Sand

Figure 1.2.

Figure 1.3. Sequence of Dicosmoecus gilvipes development at Big Elk Creek, Spring 1986. Number of larvae collected for instar determination on each date: Feb 23, n = 23; March 4, n = 43; March 27, n = 43; April 10, n = 50; May 15, n = 47; May 29, n = 51; June 17, n = 19. Bar represents 100% of each day's collection.

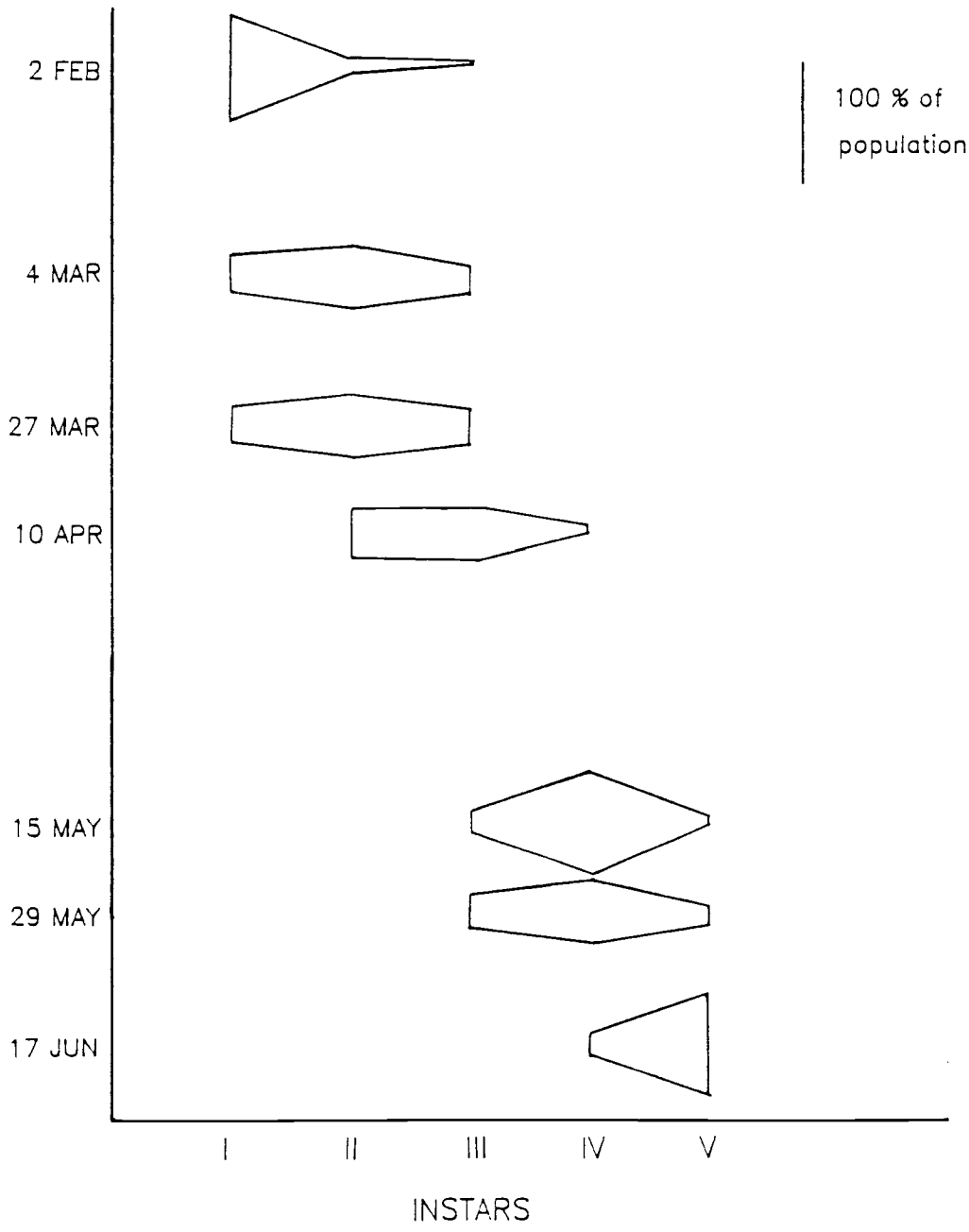

2 FEB
4 MAR
27 MAR
10 APR
15 MAY
29 MAY
17 JUN
100 % of
population
I
II
III
IV
V
INSTARS

Figure 1.3.

Table 1.2. Mean abundances of scrapers at Big Elk Creek, 1986 (mean numbers/m^2). Numbers in parentheses are standard deviations.

	20 Mar	10 Apr	22 Apr	14 May	28 May	16 June	30 June
Dicosmoecus, Instar III	1.4 (6.0)	10.2 (16.1)	1.3 (6.8)	1.9 (7.1)	0.1 (0.9)		
Dicosmoecus, Instar IV		0.8 (2.4)	2.1 (9.2)	3.3 (10.7)	5.2 (11.0)	0.04 (0.2)	
Dicosmoecus, Instar V				2.1 (7.7)	0.1 (1.1)	0.2 (5.4)	0.2 (1.1)
Total Dicosmoecus	1.4 (6.0)	11.0 (4.1)	3.4 (2.9)	7.3 (4.5)	5.4 (2.8)	0.2 (1.3)	0.2 (0.3)
Juga	40 (62)	44 (52)	68 (56)	48 (58)	44 (49)	72 (55)	36 (44)
Lithoglyphus	48 (70)	28 (34)	44 (38)	56 (39)	32 (41)	76 (93)	72 (91)
Glossosomatidae		3 (2)	1 (4)	67 (39)	40 (21)	54 (17)	15 (9)

Table 1.3 Mean depth and velocities associated with Dicosmoecus instars. Values are averages of quadrats where each instar occurred.

Numbers in parentheses are standard deviations. n = Numbers of individuals per day.

Instar	2 Feb	4 Mar	20 Mar	10 Apr	22 Apr	14 May	30 May	16 June	30 June
				MEAN VELOCITY (m/s)					
I	0.07	0.08 (0.11)							
n	18	83							
II		0.07 (0.09)	0.11 (0.15)	0.08 (0.18)					
n		73	44	123					
III		0.10 (0.18)	0.22 (0.27)	0.16 (0.10)	0.10 (0.11)				
n		25	115	26	101				
IV				0.18 (0.23)	0.34 (0.21)	0.15 (0.19)	0.14 (0.16)		
n				9	41	175	227		
V						0.18 (0.17)	0.10 (0.19)	0.14 (0.16)	0.17 (0.28)
n						111	6	58	8
				MEAN DEPTH (cm)					
I	1 (1)	11 (8)							
II	3 (11)	14 (8)	10 (9)	15 (7)					
III			22 (13)	20 (12)	28 (11)				
IV				22 (10)	38 (7)	35 (11)	22 (11)		
V						35 (9)	22 (12)	22 (9)	13 (6)

Figure 1.4. Comparison of Dicosmoecus instar abundances occurring at different depths in Big Elk Creek (March - June 1986). Small dots denote abundances within 0.25 m^2 quadrats. Bars denote numbers of quadrats represented in the stream, or where each instar occurred, in each depth category.

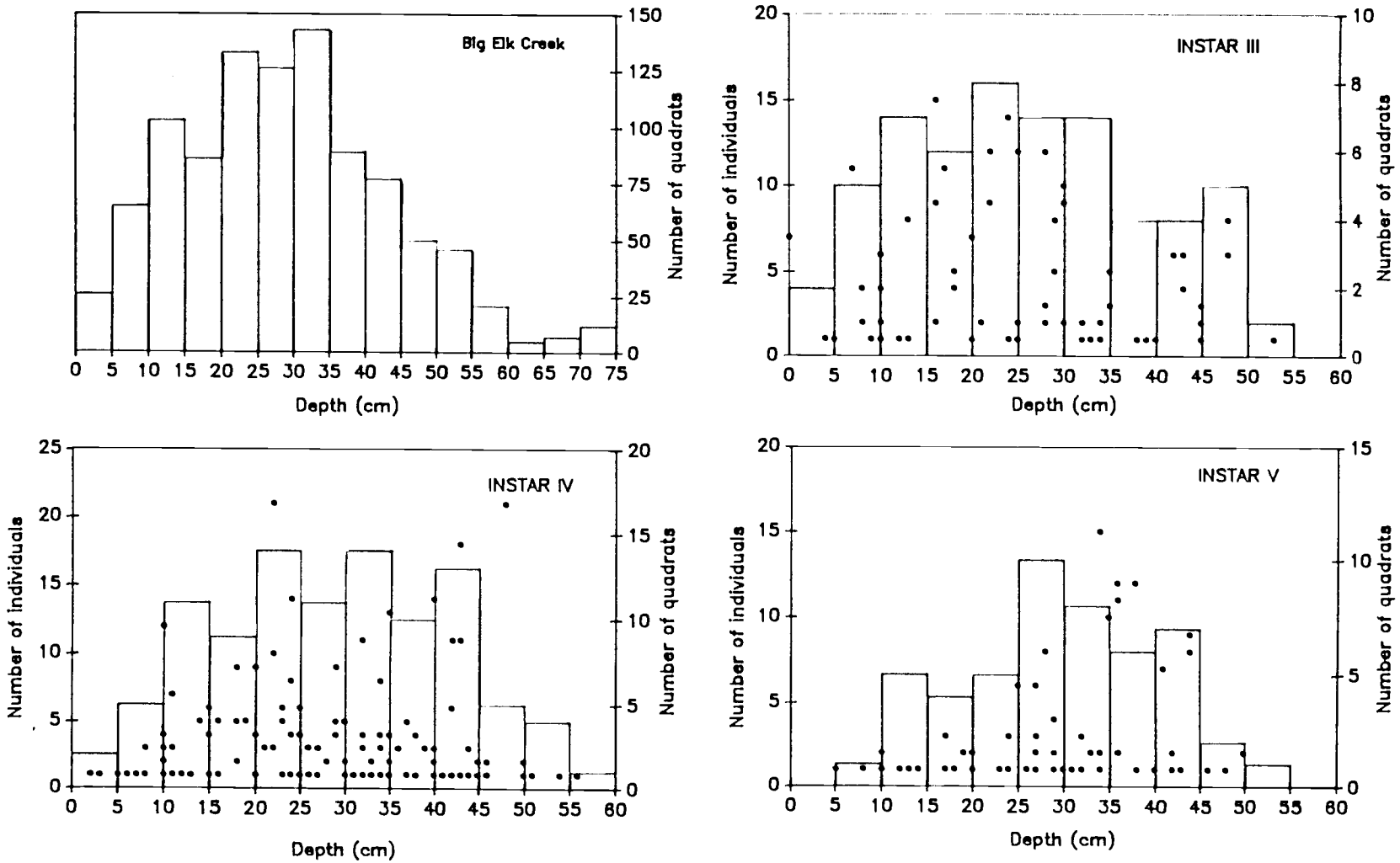
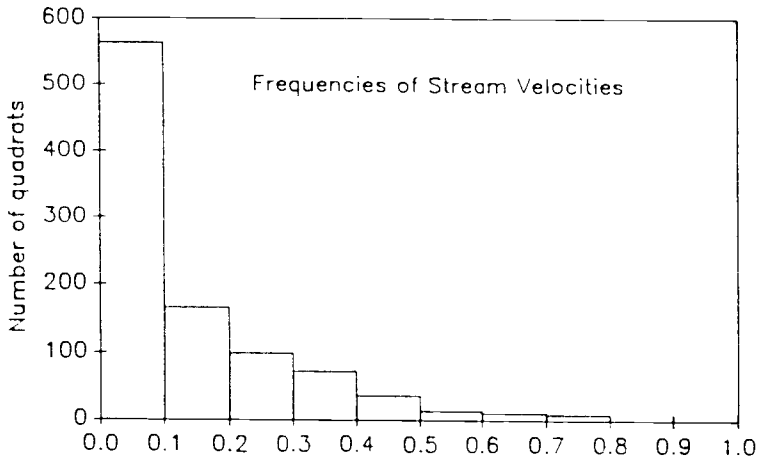
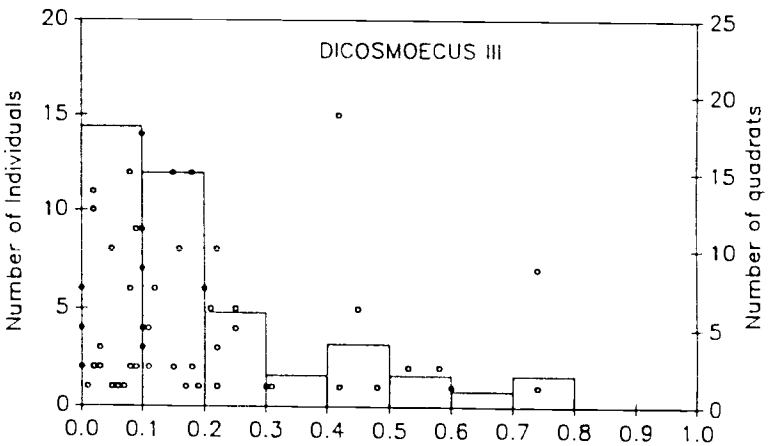
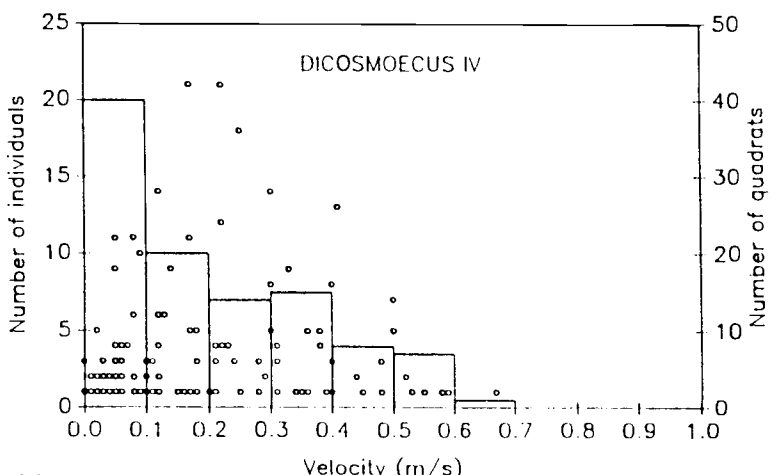

Big Elk Creek
Number of quadrats
Depth (cm)
INSTAR III
Number of individuals
INSTAR IV
INSTAR V

Figure 1.4.

Figure 1.5. Comparison of Dicosmoecus instar abundances occurring at different velocities in Big Elk Creek (March - June 1986). Small dots denote abundances within 0.25 m^2 quadrats. Bars denote numbers of quadrats represented in the stream or where each instar occurred in each velocity category.


Frequencies of Stream Velocities
Number of quadrats
600
500
400
300
200
100
0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0


DICOSMOECUS III
Number of Individuals
Number of quadrats
20
15
10
5
0
25
20
15
10
5
0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0


DICOSMOECUS IV
Number of individuals
Number of quadrats
25
20
15
10
5
0
50
40
30
20
10
0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Velocity (m/s)

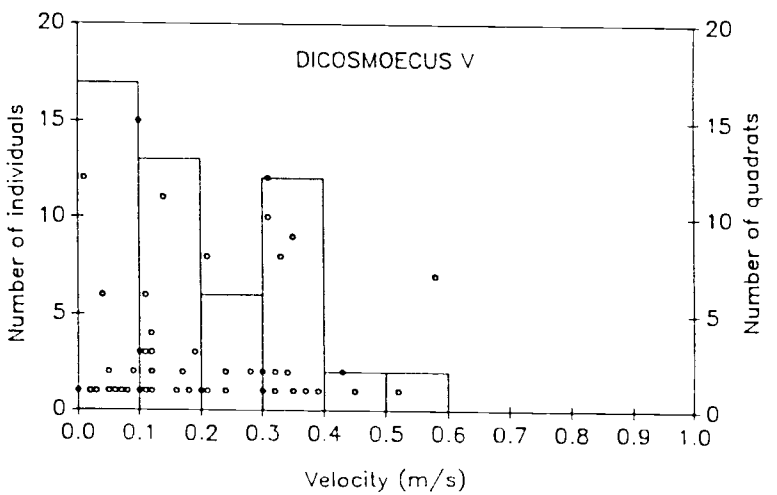

DICOSMOECUS V
Number of individuals
Number of quadrats
20
15
10
5
0
20
15
10
5
0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Velocity (m/s)

Figure 1.5.

Substrate sizes occupied by third-, fourth-, and fifth-instar D. gilvipes reflected concomitant changes in distribution. Small boulders were preferred by third- and fourth-instar larvae, but fourth-instar larave did not demonstrate strong preferences (Table 1.4). Bedrock, the most common substrate (Fig. 1.2), was not preferred nor avoided by any instar. Third-, fourth-, and fifth-instar larvae avoided rubble/pebble size classes. Both third- and fifth-instar larvae avoided sand; third-instar larvae also avoided cobble. Third-instar D. gilvipes probably avoided more substates because they occupied shallow locations where some substrate sizes did not occur. However, third-instar larvae generally were not found in stream margins and they avoided sand found commonly in those habitats.

Dicosmoecus distributions for each instar (larvae/m^2) were random when abundances for each instar were analyzed for the entire field season, (i.e. distributions were not significantly different from a Poisson; Fig. 1.6). These frequency distributions were derived from pooling abundances in all sampling quadrats. Shapes of these distributions were strongly affected by high proportions of quadrats where there were no larvae. Distribution of larvae examined as contiguous patches revealed that Dicosmoecus larvae occurred in discrete patches from 1.0 to 6.0 m wide (Fig. 1.7). Distinct aggregations became apparent when analysis was focused on distributions of specific locales and days.

Dicosmoecus Behavior

Dicosmoecus activities were described from observations of 96 individuals. Behavioral activities varied significantly between Dicosmoecus instars ($p < 0.10$, G-test)(Fig. 1.8). Interactions among second-instar larvae were more frequent than among other instars, primarily because second-instar larvae clung to one another. Clinging behavior appeared to be a way of moving within stream margins. No apparent aggressive interactions occurred among any instars. Third- and fifth-instar larvae most frequently were resting, and fourth-instar larvae were most often observed crawling.

Table 1.4 Electivity indices for substrates associated with Dicosmoecus, Juga, Lithoglyphus, and Glossosomatidae. E* = 1.0 denotes preference, E* = -1.0 denotes avoidance.

	Dicomoecus Instar III		Dicomoecus Instar IV		Dicomoecus Instar V
Small Boulder	0.2773	Bedrock	0.1134	Small Boulder	0.3226
Coarse Gravel	0.1480	Small Boulder	0.0610	Bedrock	0.0351
Bedrock	0.0158	Sand	-0.0036	Coarse Gravel	-0.1045
Fine Gravel	-0.1034	Fine Gravel	-0.141	Fine Gravel	-0.1657
Large Boulder	-0.1034	Large Boulder	-0.0141	Large Boulder	-0.1657
Cobble	-0.2251	Coarse Gravel	-0.1041	Cobble	-0.1943
Sand	-0.3619	Cobble	-0.1062	Rubble/Pebble	-0.2802
Rubble/Pebble	-0.7784	RubblePebble	-0.2802	Sand	-0.3392
	Juga		Lithoglyphus		Glossosomatidae
Fine Gravel	-0.0304	Coarse Gravel	0.0091	Cobble	0.0950
Large Boulder	-0.0304	Cobble	-0.0166	Coarse Gravel	0.0159
Coarse Gravel	-0.0416	Fine Gravel	-0.0356	Fine Gravel	-0.0196
Cobble	-0.0417	Large Boulder	-0.0356	Large Boulder	-0.0196
Small Boulder	-0.0607	Small Boulder	-0.0793	Sand	-0.0533
Sand	-0.0755	Sand	-0.1006	Small Boulder	-0.0546
Bedrock	-0.1094	Rubble/Pebble	-0.1361	Rubble/Pebble	-0.1774
Rubble/Pebble	-0.1574	Bedrock	-0.1635	Bedrock	-0.4943

Figure 1.6. Frequency distributions of third-, fourth-, and fifth-instar Dicosmoecus abundances (larvae/m^2) for March 20 - June 30, 1986 in Big Elk Creek.

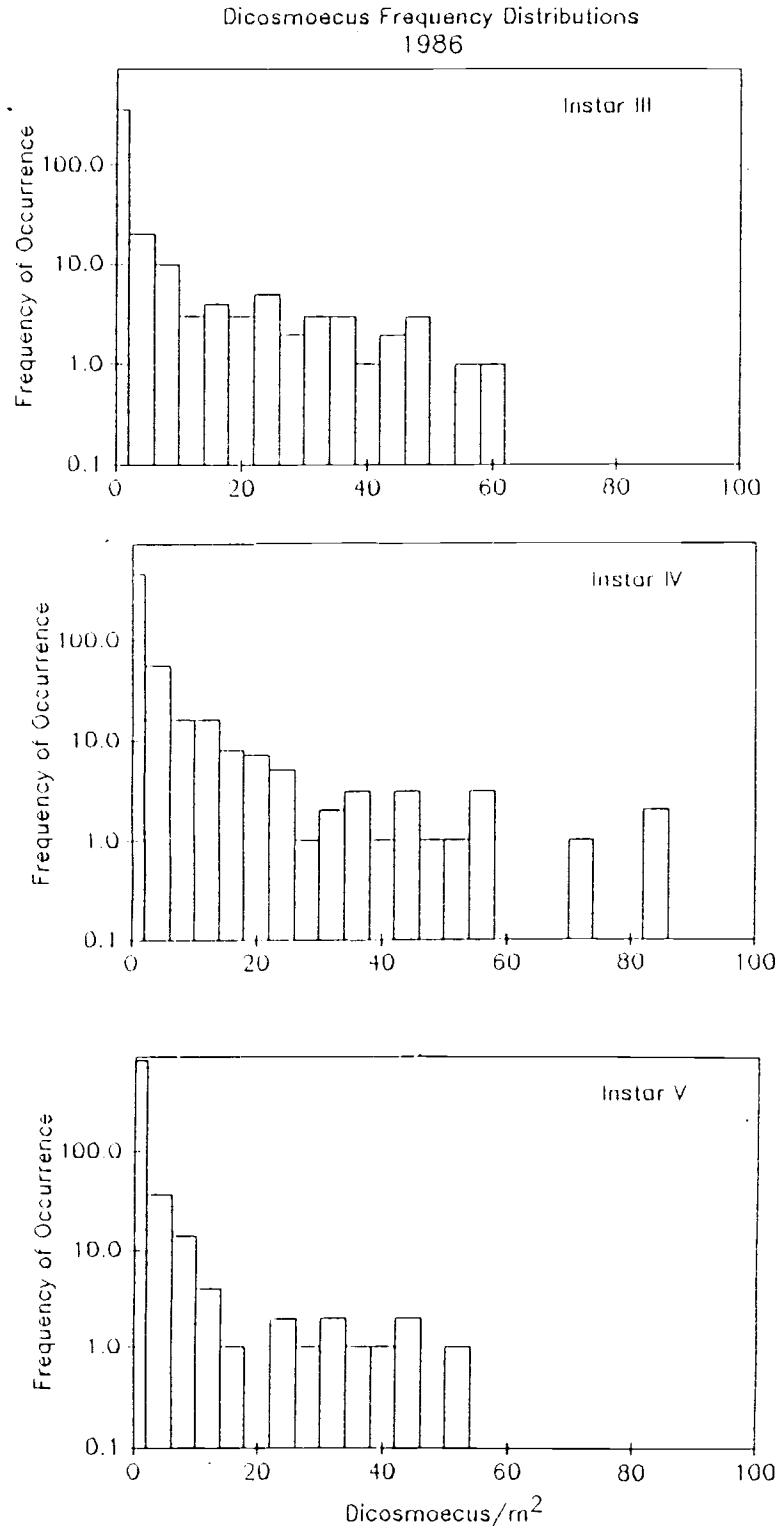

Dicosmoecus Frequency Distributions
1986
Instar III
Instar IV
Instar V
Frequency of Occurrence
100.0
10.0
1.0
0.1
0
20
40
60
80
100
Dicosmoecus/m2

Figure 1.6.

Figure 1.7. Frequency of patch widths (widths of contiguous occupied quadrats) for Dicosmoecus, Juga, Lithoglyphus, and Glossosomatids in Big Elk Creek.

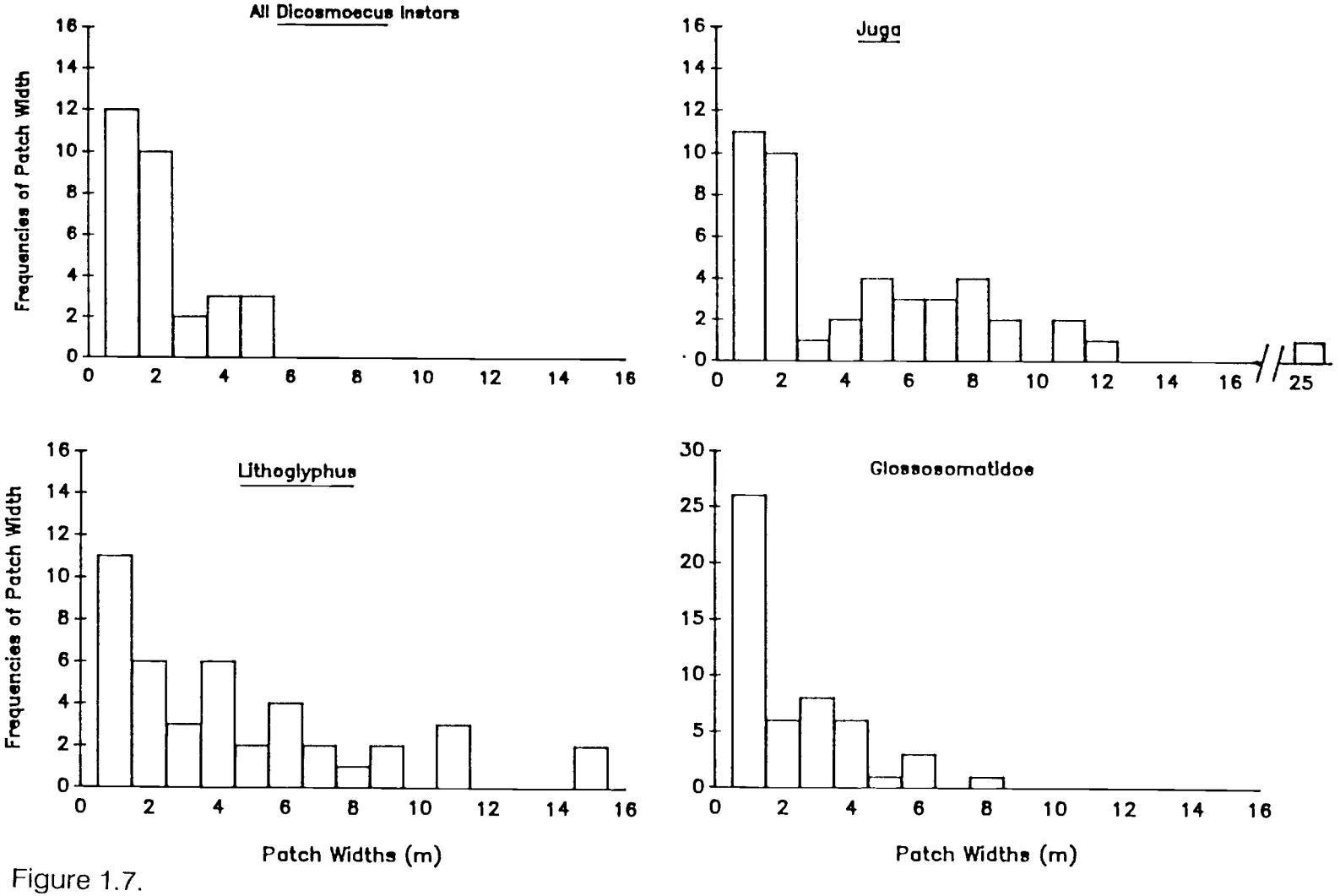

All Dicosmoecus Instars
Juga
Lithoglyphus
Glossosomatidae
Frequencies of Patch Width
Patch Widths (m)

Figure 1.7.

Figure 1.8. Proportion of behavioral activities observed for different instars of Dicosmoecus at Big Elk Creek (instar II, n = 25; instar III, n = 23; instar IV, n = 13; instar V, n = 34).

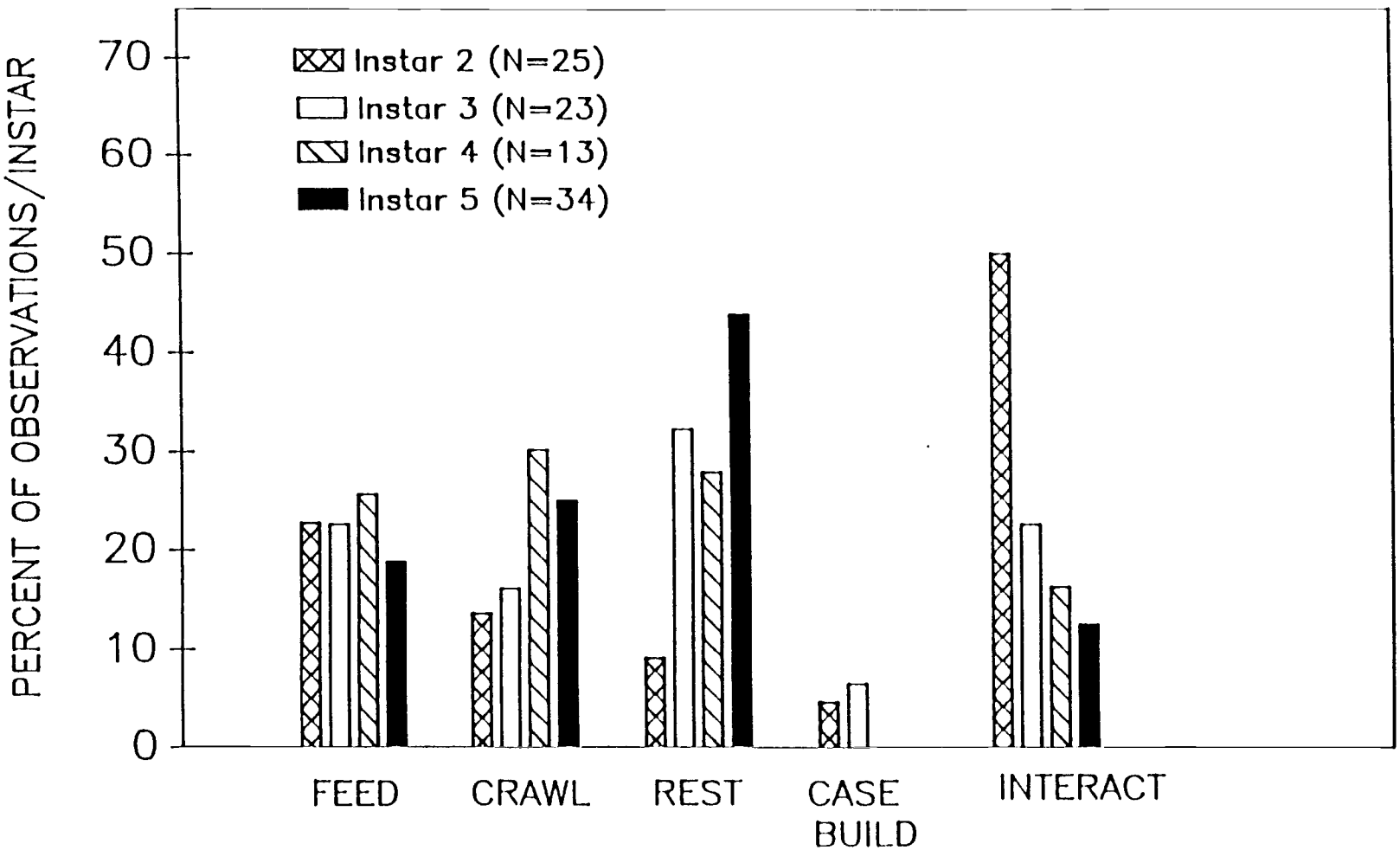

PERCENT OF OBSERVATIONS/INSTAR
70
60
50
40
30
20
10
0
Instar 2 (N=25)
Instar 3 (N=23)
Instar 4 (N=13)
Instar 5 (N=34)
FEED
CRAWL
REST
CASE BUILD
INTERACT

Figure 1.8.

Crawling speeds were determined from observations of 139 individuals, including both those observed in behavioral cataloging and additional larvae. Fastest speeds were exhibited by fifth-instar larvae (41 individuals) that were crawling on bedrock substrate (mean = 1.8 cm/min). Fourth-instar larvae (45 individuals) crawled at a slower pace within riffle habitat than on bedrock (mean = 0.4 cm/min), and rates were less variable than those of fifth-instar larvae. Differences in flow and substrate may have contributed to variations in speed. In stream margins speeds of second- (28 individuals) and third-instar larvae (25 individuals) were not significantly different (means = 0.3, 0.4 cm/min respectively) ($p < 0.05$, Kolmogorov-Smirnov test).

Dicosmoecus instars did not vary significantly in the amount of angles they turned while crawling ($p < 0.10$ level, G-test). However, a high proportion of second-, third-, and fourth-instar larvae moved in a zig-zag fashion (44%, 47%, and 71% respectively)(Figure 1.9). Forty-seven percent of fifth-instar larvae moved in linear patterns at higher crawling speed. Larvae that moved in a "patchy" fashion turned around towards the position where they were first observed. Approximately 30% of third- and fifth-instar larvae traced patchy patterns (Figure 1.9).

Distribution and Abundance of Other Herbivores

Juga and Lithoglyphus generally were the most abundant herbivores during the five months of the study, and were distributed widely across the stream. These snails occurred in habitats where depths and velocities were similar to the range occurring in the stream (Table 1.5, Fig. 1.10, 1.11). Both snail taxa were found at lower velocities and shallower depths in late May and June, in comparison to earlier spring (Table 1.5). These differences corresponded to average velocities and depths in the stream.

Glossosomatid caddisflies were first observed on April 10 and were most abundant on May 14 when small glossosomatids, probably Agapetus, were numerous (Table 1.2). Abundance remained high from late May through June 16. Few glossosomatids were found in depths less than 10 cm;

Figure 1.9. Proportion of movement patterns exhibited by instars of Dicosmoecus at Big Elk Creek.

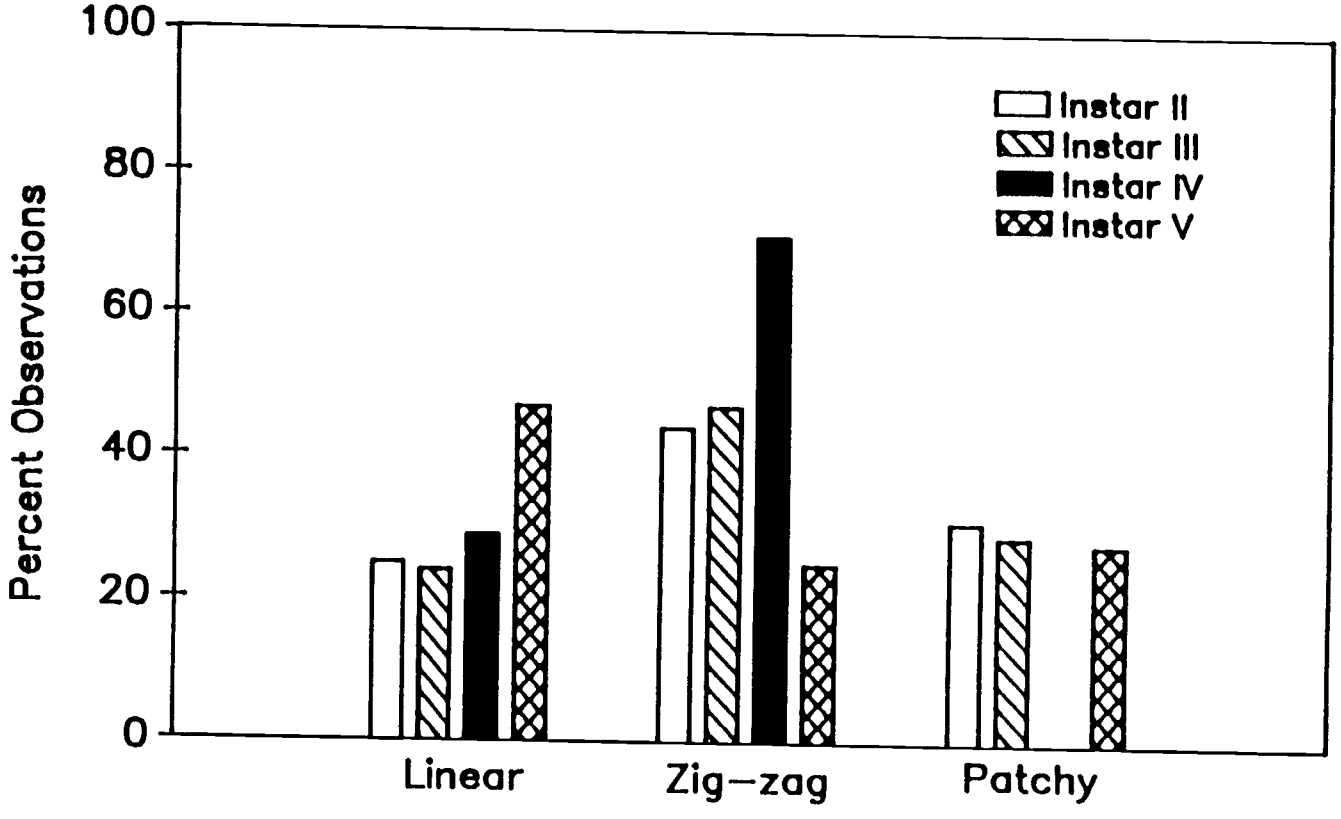

100
80
60
40
20
0
Percent Observations
Instar II
Instar III
Instar IV
Instar V
Linear
Zig–zag
Patchy

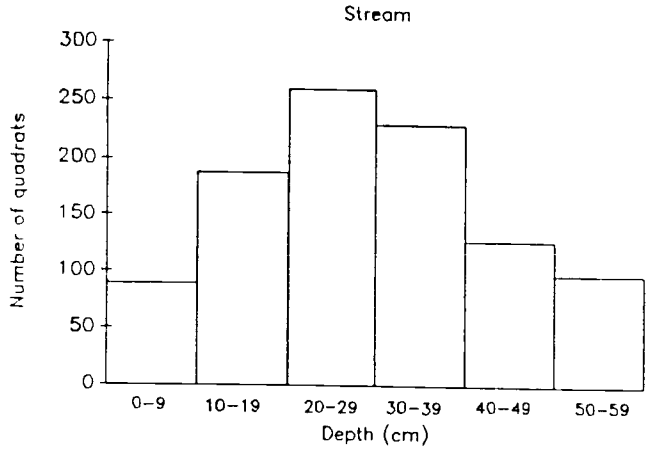
Figure 1.9.

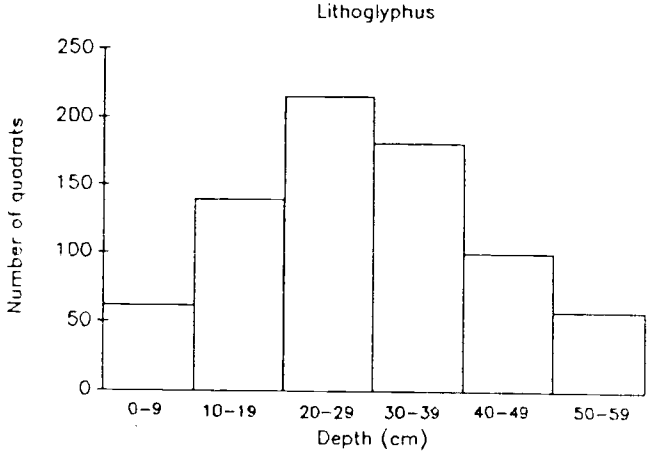
Table 1.5 Mean velocities and depths where Juga, Lithoglyphus, and glossosomatid caddisflies occurred on each sampling day at Big Elk Creek.

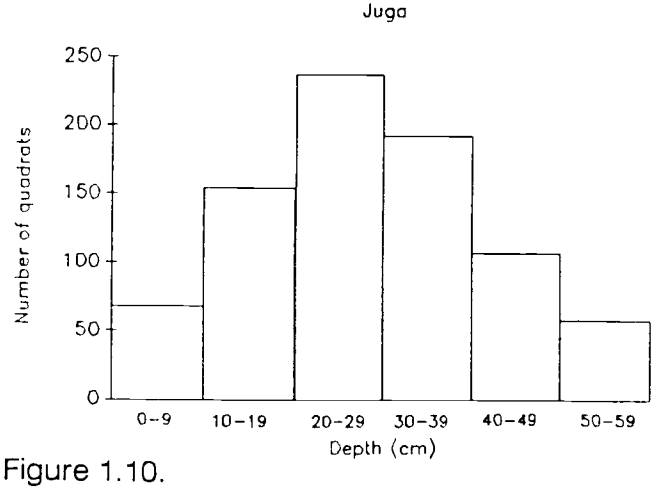
Numbers in parentheses are standard deviations.

	20March	10April	22April	14May	30May	16June	30June
			Mean Velocities (m/s)				
Stream	0.19 (0.26)	0.20 (0.24)	0.17 (0.14)	0.14 (0.17)	0.16 (0.22)	0.10 (0.14)	0.13 (0.22)
Juga	0.11 (0.19)	0.14 (0.21)	0.16 (0.15)	0.12 (0.16)	0.12 (0.15)	0.09 (0.12)	0.05 (0.21)
Lithoglyphus	0.19 (0.26)	0.21 (0.23)	0.17 (0.16)	0.12 (0.15)	0.13 (0.14)	0.08 (0.10)	0.04 (0.20)
Glossosomatidae	n.a.	0.18 (0.23)	0.22 (0.00)	0.14 (0.18)	0.15 (0.17)	0.03 (0.14)	0.04 (0.18)
			Mean Depths (cm)				
Stream	35 (16)	22 (13)	39 (17)	37 (14)	24 (12)	25 (12)	21 (13)
Juga	31 (16)	20 (12)	40 (17)	38 (14)	24 (11)	25 (12)	22 (14)
Lithoglyphus	34 (15)	24 (14)	39 (17)	38 (14)	25 (11)	25 (12)	22 (13)
Glossosomatidae	n.a.	19 (10)	35 (14)	40 (11)	25 (10)	20 (8)	18 (9)

Figure 1.10. Comparison of Juga, Lithoglyphus, and Glossosomatidae abundances occurring at different depths at Big Elk Creek (March - June 1986). Bars denote numbers of quadrats where each taxon occurred in each depth category. Graph of stream depths summarizes number of quadrats available in the stream.


Stream
Number of quadrats
300
250
200
150
100
50
0
0-9
10-19
20-29
30-39
40-49
50-59
Depth (cm)


Lithoglyphus
Number of quadrats
250
200
150
100
50
0
0-9
10-19
20-29
30-39
40-49
50-59
Depth (cm)


Juga
Number of quadrats
250
200
150
100
50
0
0-9
10-19
20-29
30-39
40-49
50-59
Depth (cm)

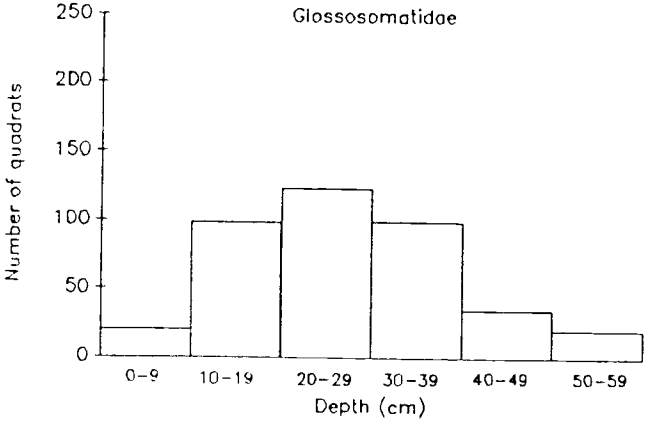
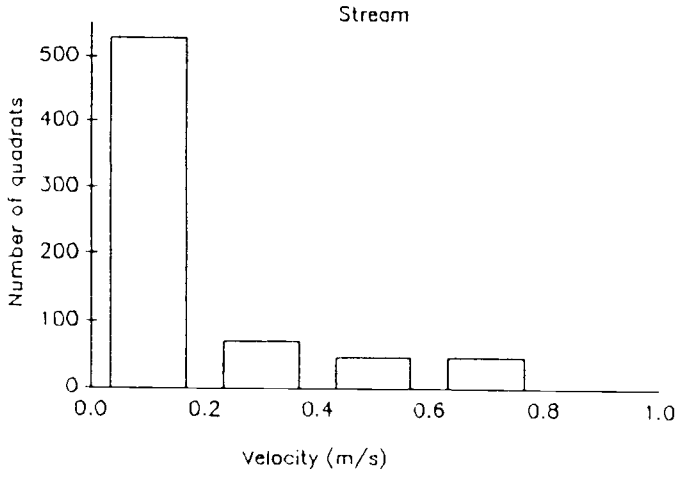
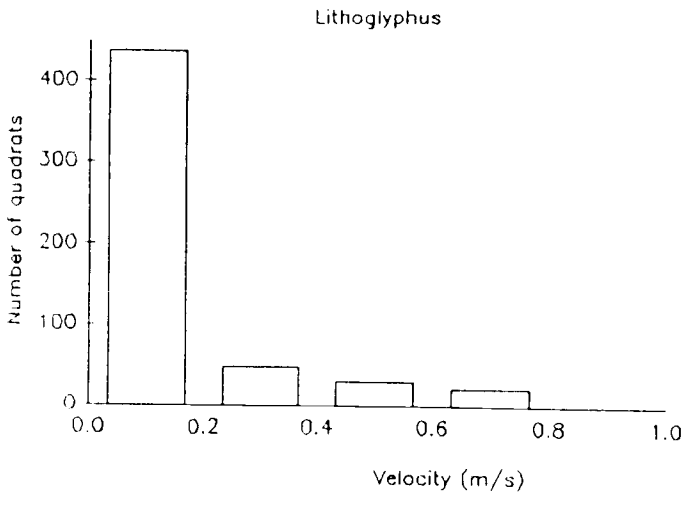

Glossosomatidae
Number of quadrats
250
200
150
100
50
0
0-9
10-19
20-29
30-39
40-49
50-59
Depth (cm)

Figure 1.10.

Figure 1.11. Comparison of Juga, Lithoglyphus, and Glossosomatidae abundances occurring at different velocities at Big Elk Creek (March - June 1986). Bars denote numbers of quadrats where each taxon occurred in each velocity category. Graph of stream velocities summarizes number of quadrats available in the stream.


Stream
Number of quadrats
500
400
300
200
100
0
0.0
0.2
0.4
0.6
0.8
1.0
Velocity (m/s)


Lithoglyphus
Number of quadrats
400
300
200
100
0
0.0
0.2
0.4
0.6
0.8
1.0
Velocity (m/s)

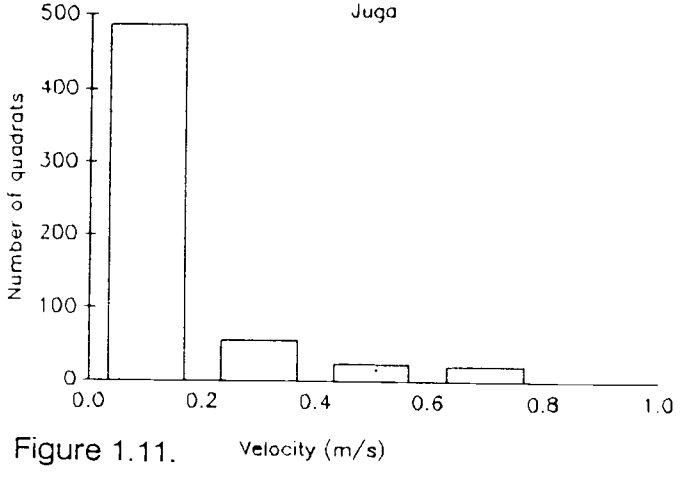
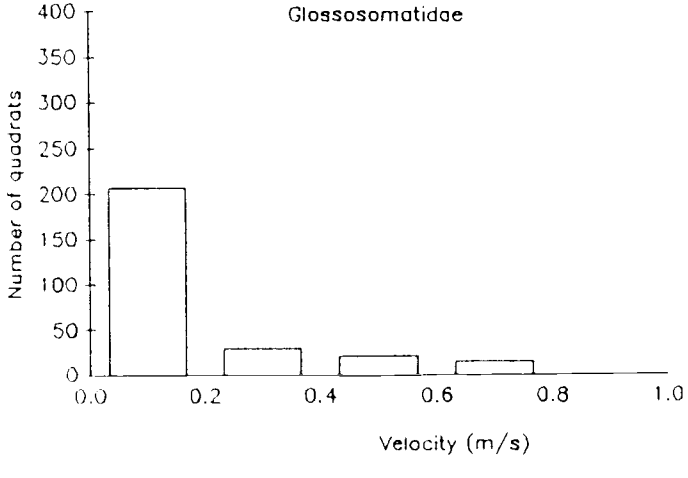

Juga
Number of quadrats
500
400
300
200
100
0
0.0
0.2
0.4
0.6
0.8
1.0
Velocity (m/s)

Figure 1.11.


Glossosomatidae
Number of quadrats
400
350
300
250
200
150
100
50
0
0.0
0.2
0.4
0.6
0.8
1.0
Velocity (m/s)

otherwise, habitats where these caddisflies occurred were similar to the of depths and velocities available in the stream (Fig. 1.10, 1.11).

Snails did not prefer or avoid most substrates (i.e., E* values close to zero), but Juga avoided rubble/pebble (E* = -0.1574) and Lithoglyphus avoided bedrock (E* = -0.1635)(Table 1.4). Glossosomatids did not prefer any substrate size, avoided rubble/pebble, and strongly avoided bedrock (E* = -0.4943).

Comparisons of Dicosmoecus and Other Herbivores

Dicosmoecus abundances were not strongly associated with total herbivore abundances because Dicosmoecus were most numerous as early-instar larvae in April, whereas snails and Glossosomatidae were most numerous in May and June (Table 1.2). Dicosmoecus comprised a small proportion of total herbivore numbers; when Dicosmoecus were most abundant in April they comprised 13% of all herbivores, and less then 1% by late June (Table 1.2). Snails comprised the majority of herbivores (73%) and were most abundant on June 16. Two weeks later, Juga abundances had decreased from 72 to 36/m^2, while Lithoglyphus numbers remained high.

Herbivore density and algal standing crop were not significantly correlated ($t = 1.07$, $p < 0.10$, Student's t)(Fig. 1.12). In early spring, mean herbivore abundance increased with increasing standing crop of chlorophyll *a*. Dicosmoecus abundance peaked in April before chlorophyll abundance increased, began declining in May, and were less than 1/m^2 in June (Fig. 1. 13). Snail and glossosomatid abundances increased with increasing chlorophyll abundance until May 29 when mean herbivore densities within the study reach declined from 178 to 149 herbivores/m^2 (Fig. 1.14). Mean numbers of snails and glossosomatids rose again between May 29 and June 17, when algal abundance decreased; by late June algal abundance had increased while total herbivore abundance decreased. Lower numbers of Juga (36/m^2) and glossosomatid caddisflies (15/m^2) accounted for the decrease on June 30. Lithoglyphus remained high (72/m^2) on this date (Table 1.2).

Figure 1.12. Relationship between total herbivore densities and abundance of chlorophyll a in Big Elk Creek during March - June 1986.

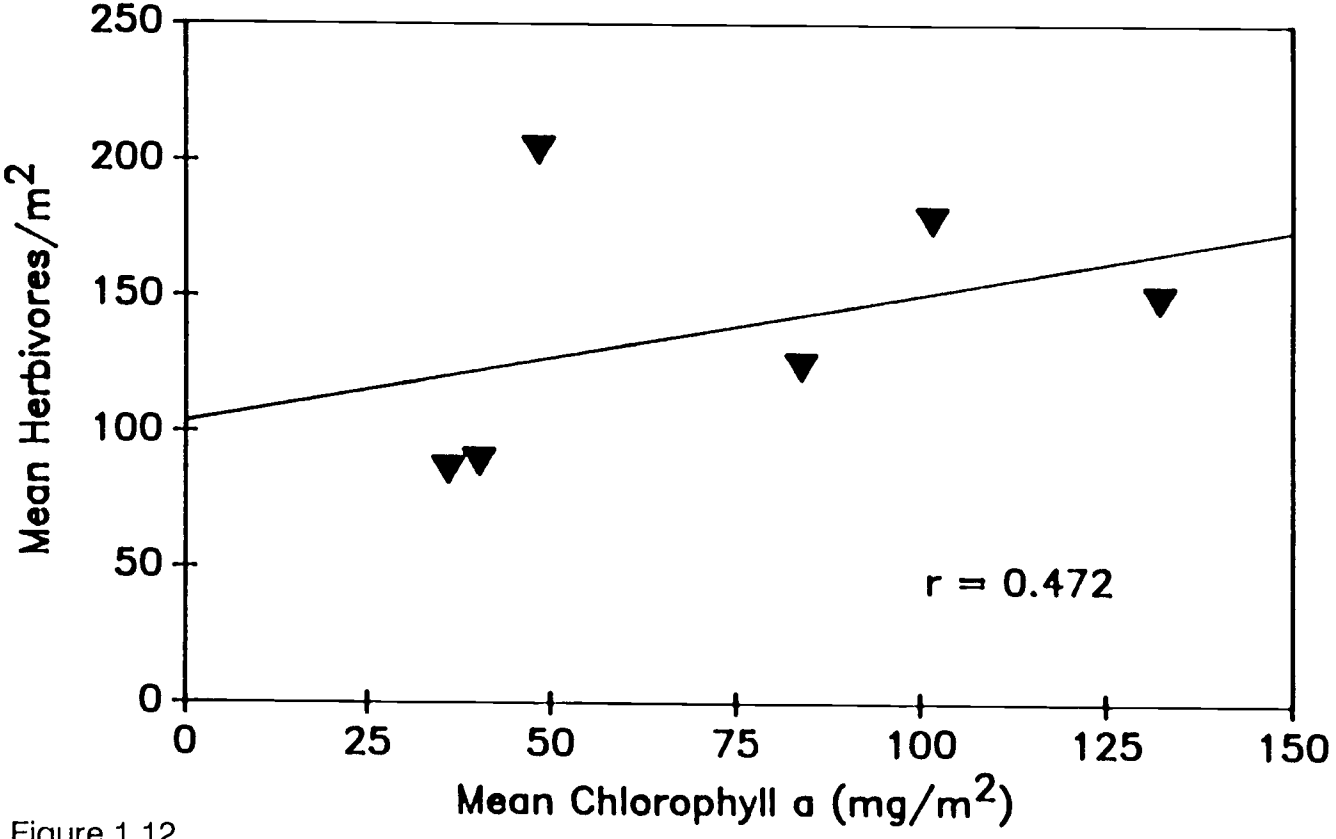

250
200
150
100
50
0
Mean Herbivores/m2
0
25
50
75
100
125
150
Mean Chlorophyll a (mg/m2)
r = 0.472

Figure 1.12.

Figure 1.13. Seasonal changes in Dicosmoecus densities and abundance of chlorophyll a (mg/m^2) at Big Elk Creek in 1986.

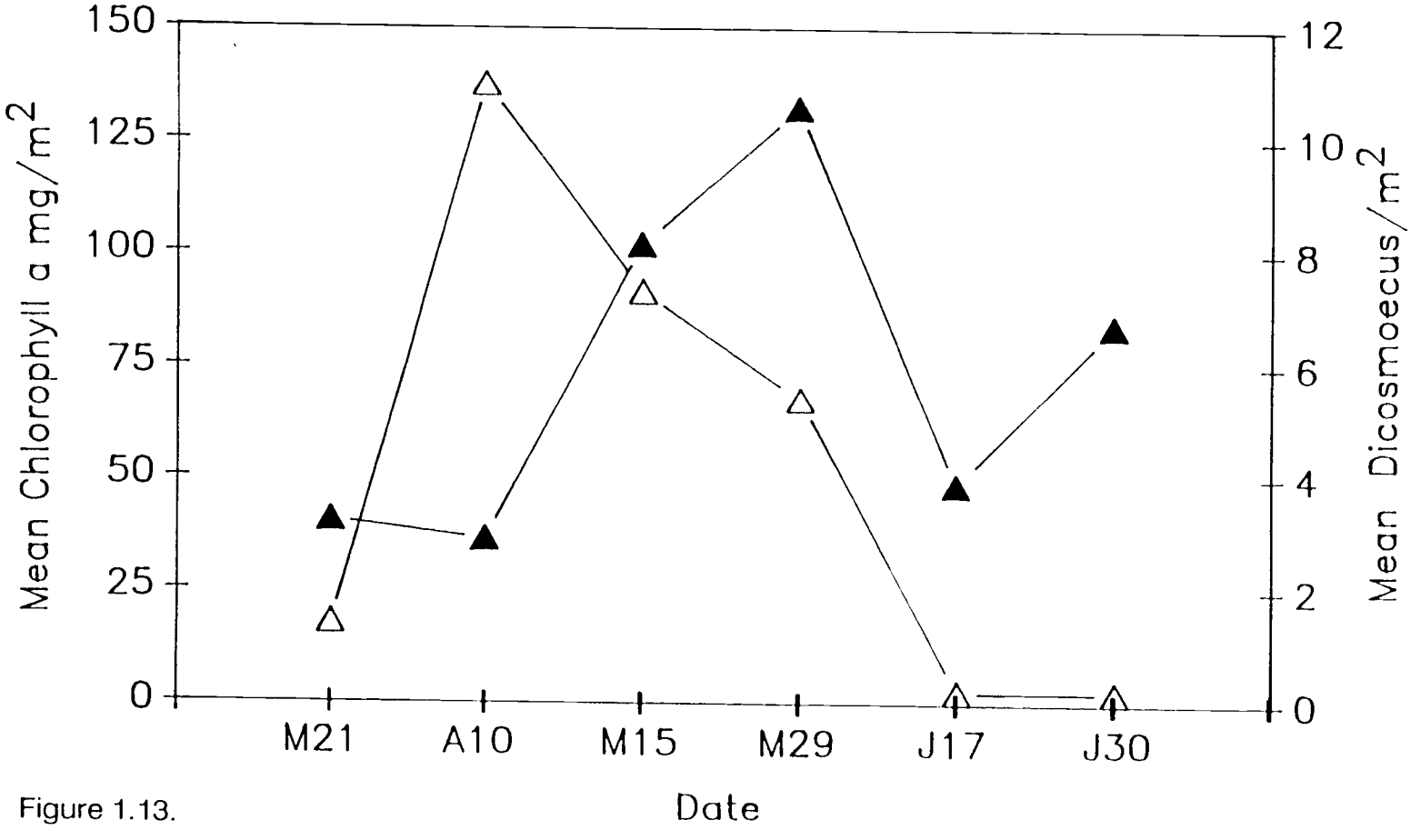

150
125
100
75
50
25
0
Mean Chlorophyll a mg/m2
12
10
8
6
4
2
0
Mean Dicosmoecus/m2
M21
A10
M15
M29
J17
J30
Date

Figure 1.13.

Figure 1.14. Seasonal patterns of total herbivore density and abundance of chlorophyll a (mg/m^2) in Big Elk Creek during March - June 1986. (triangles represent chlorphyll a abundance, circles represent herbivore density).

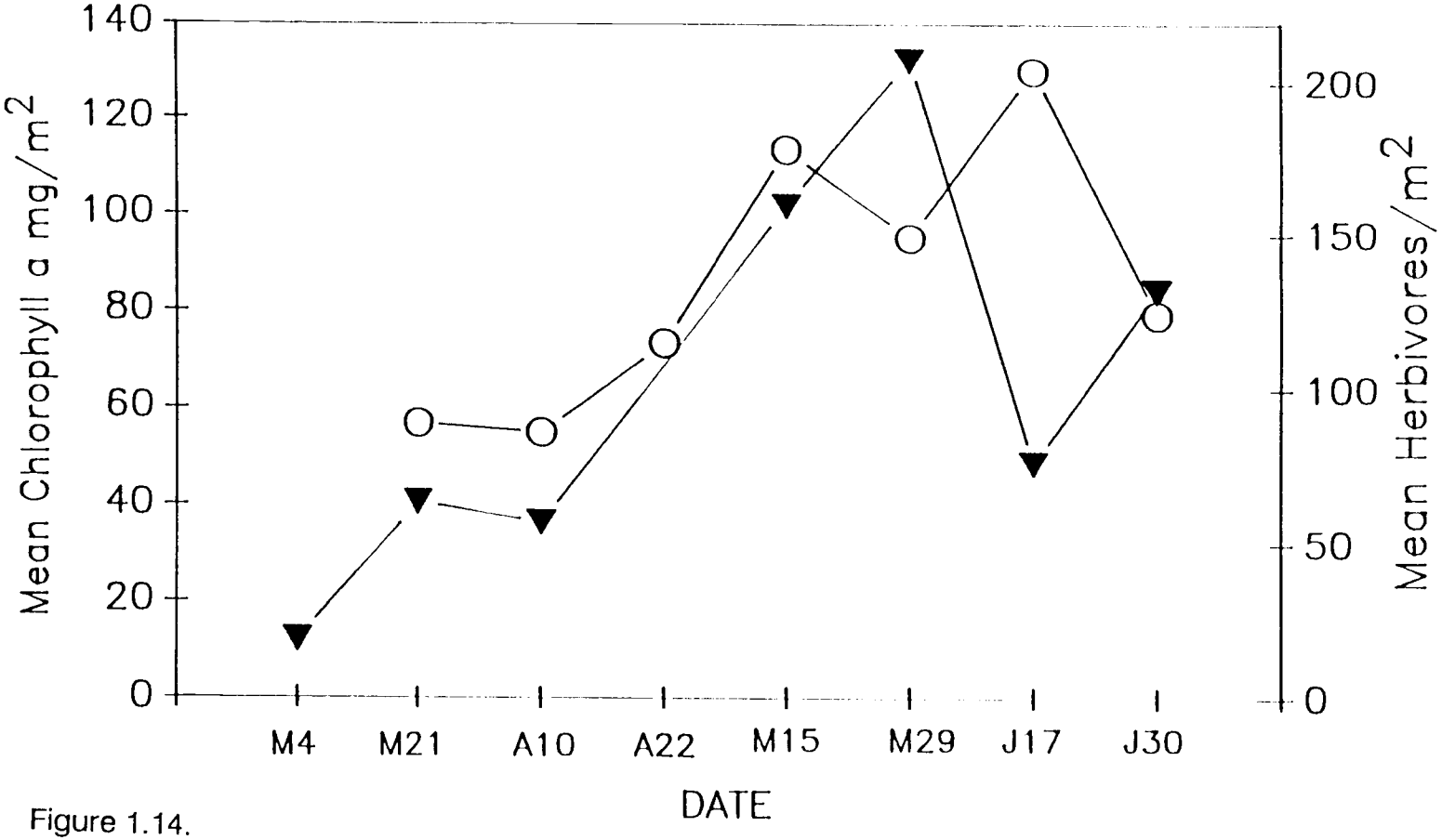

140
120
100
80
60
40
20
0
Mean Chlorophyll a mg/m2
200
150
100
50
0
Mean Herbivores/m2
M4
M21
A10
A22
M15
M29
J17
J30
DATE

Figure 1.14.

Dicosmoecus larvae were found in higher velocities as they grew older, whereas snails and glossosomatid caddisflies were more widely distributed, and generally occurred in slower velocities in late spring (Table 1.5). The trend among snails reflected their broad distribution across most of the available habitat, particularly in May and June.

Stream depths where Dicosmoecus was found reflected life history patterns of migration between shallow and deeper mid-channel habitats, but snails did not demonstrate marked changes in distribution during the sampling period. On March 20, second- and third-instar Dicosmoecus were in shallow waters (10.4 and 22 cm depths respectively) while snails were found in deeper waters (Juga at mean depth = 31 cm, Lithoglyphus at mean depth = 34 cm)(Table 1.3,1.5). Third-instar D. gilvipes larvae occupied significantly shallower habitats in comparison to other herbivores on April 22 ($p < 0.005$, Mann-Whitney), but there were no significant differences among herbivores with respect to depth in May. By June 30 fifth-instar larvae had moved back to shallow habitats, possibly in preparation for prepupal diapause (mean depth = 0.17 cm). Glossomatidae occurred in habitats significantly more shallow than other herbivores on June 16 (mean depth = 20 cm)($p < 0.005$ Friedman test). A new cohort of glossosomatids, probably Glossosoma penitum, were very small and abundant on this date.

Dicosmoecus were less abundant and more patchy in their distribution than other herbivores in the Big Elk; nevertheless distribution among all herbivores often overlapped because snail distribution was quite broad. During behavioral observations of Dicosmoecus co-occurring with other scrapers, aggression towards snails was never observed. Dicosmoecus occasionally crawled over snails or other caddisflies, but interaction was brief.

Dicosmoecus gilvipes larvae tended to prefer small boulder substrates, but snails and glossosomatids did not exhibit preferences for substrate sizes. Another contrast among these herbivores was that both snails and glossosomatids avoided bedrock, substrate neither preferred nor avoided by D. gilvipes.

The first axes of Detrended Correspondence Analysis (DCA) represented a gradient for substrate size on April 22 ($r = 0.592$, $p < 0.01$); substrate sizes increase from left to right in Fig. 1.15. There were no significant correlations with any physical factor on May 14. Both substrate size and velocity were significantly correlated to the first DCA axis for June 16 ($r = 0.262$, $p < 0.05$ for substrate, $r = 0.392$, $p < 0.01$ for velocity) (Fig. 1.17).

Aggregations of Dicosmoecus larvae, based primarily on bedrock substrates, were distinguished from sites dominated by other herbivores in DCA on April 22, May 14 and June 16 (Figs. 1.15, 1.16, 1.17). Most sites dominated by Dicosmoecus occurred contiguously, particularly sites dominated by fourth-instar larvae on April 22 (far right section of Fig. 1.15,), and by fifth-instar larvae on May 14 (upper right section of Fig. 1.16), and June 16 (upper right section of Fig. 1.17). Another fourth-instar patch is represented on May 14, where 5 of 8 sites dominated by fourth-instar larvae were contiguous (Fig. 1.16). Half the sites dominated by third-instar larvae on May 14 (lower right corner of Fig. 1.16) also comprised a contiguous patch; no particular substrates dominated these patches.

A gradient of increasing velocity on June 16 was represented by snail-dominated sites on the left side of Fig. 1.17 (velocities close to zero), and glossosomatid-dominated sites in the right corner of the graph (velocities averaged 0.31 m/s). Velocities were intermediate where fifth-instar Dicosmoecus dominated (mean velocity = 0.16 m/s).

DCA also distinguished sites where glossomatid caddisflies were abundant. On April 22 a few sites dominated by glossosomatids followed the increasing substrate gradient, but reasons for further distinction from Dicosmoecus were unclear. Numerous glossosomatid-dominated sites were distinguished from other herbivores on May 14 (far left, Fig. 1.16), though there were no correlations with any physical factors. Glossosomatids occurring at high velocities on June 16 were distributed in a contiguous patch; six out of

Figure 1.15. First and second axes ordination scores from Detrended Correspondence Analysis of 80 quadrats (0.25 m^2) in Big Elk Creek, on April 22, 1986. Each point represents a single quadrat. Dominance by particular taxa was determined by referring to species abundance for each quadrat and denoted by shapes specified in legend.

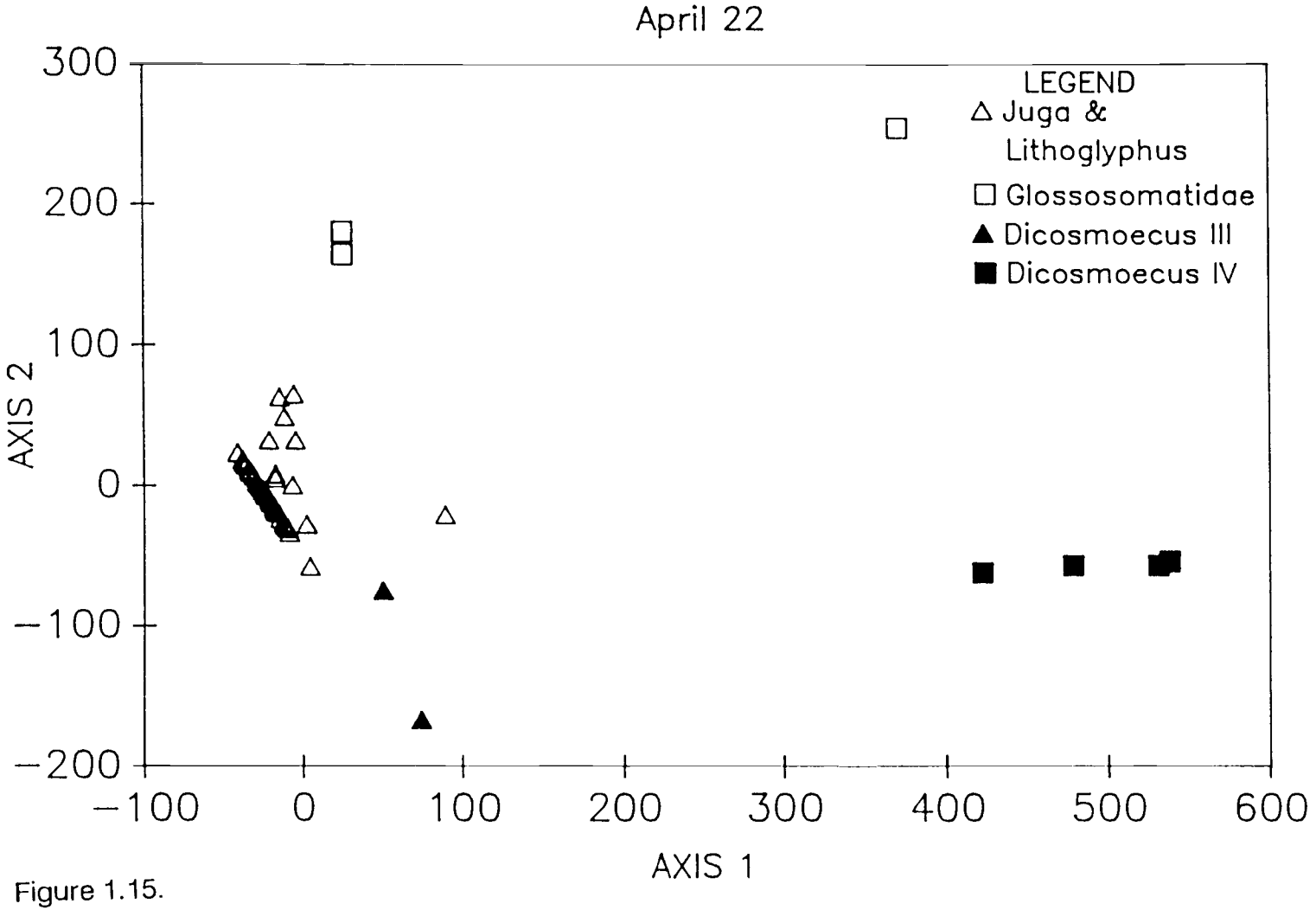

April 22
LEGEND
Juga & Lithoglyphus
Glossosomatidae
Dicosmoecus III
Dicosmoecus IV
AXIS 2
AXIS 1
300
200
100
0
−100
−200
−100
0
100
200
300
400
500
600

Figure 1.15.

Figure 1.16. First and second axes ordination scores from Detrended Correspondence Analysis of 206 quadrats (0.25 m^2) in Big Elk Creek on May 14, 1986. See Fig. 1.15 and text for details.

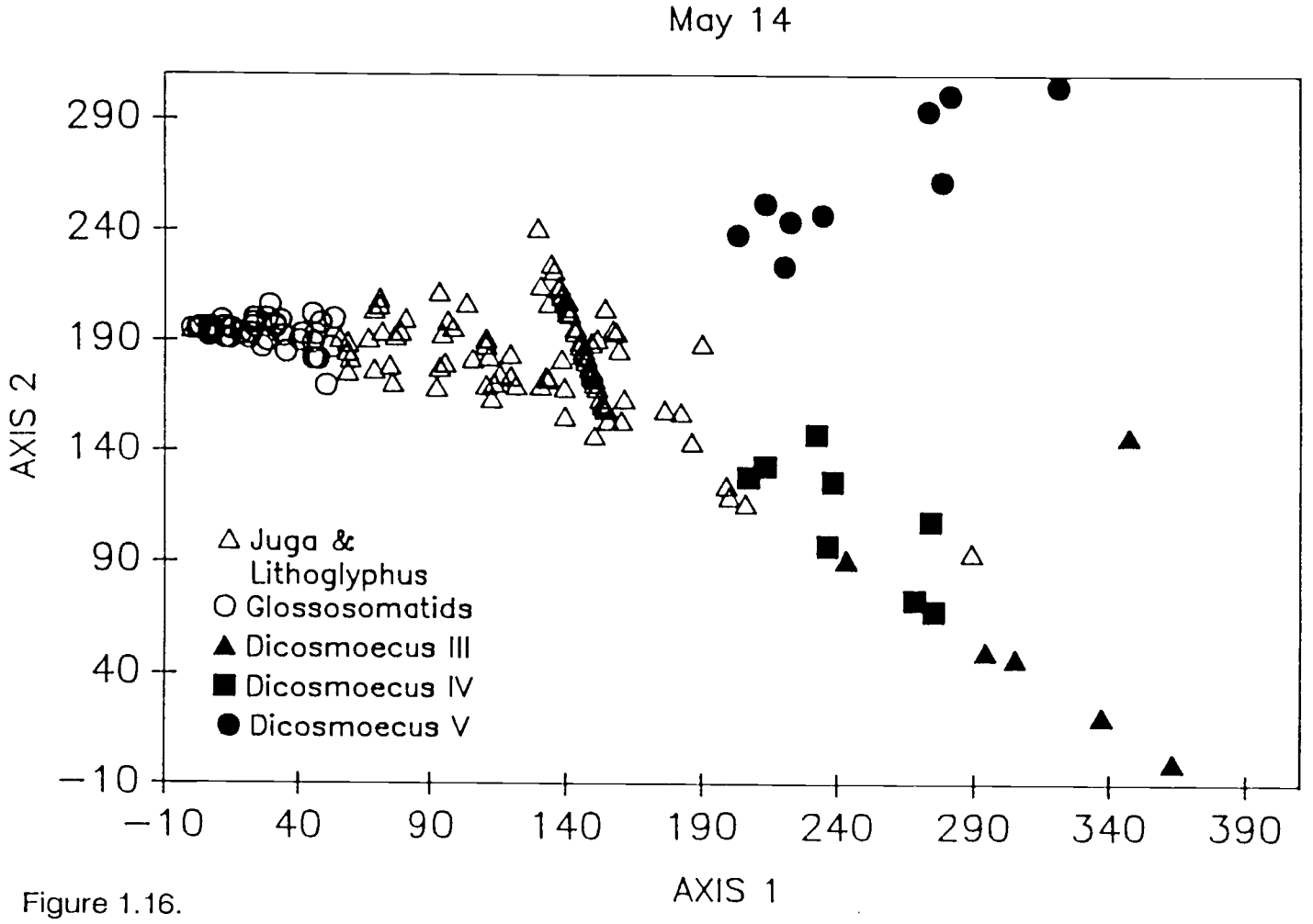

May 14
290
240
190
140
90
40
−10
AXIS 2
△ Juga & Lithoglyphus
○ Glossosomatids
▲ Dicosmoecus III
■ Dicosmoecus IV
● Dicosmoecus V
−10
40
90
140
190
240
290
340
390
AXIS 1

Figure 1.16.

Figure 1.17. First and second axes ordination scores from Detrended Correspondence Analysis of 157 quadrats (0.25 m^2) in Big Elk Creek on June 16, 1986. See Fig. 1.15 and text for details.

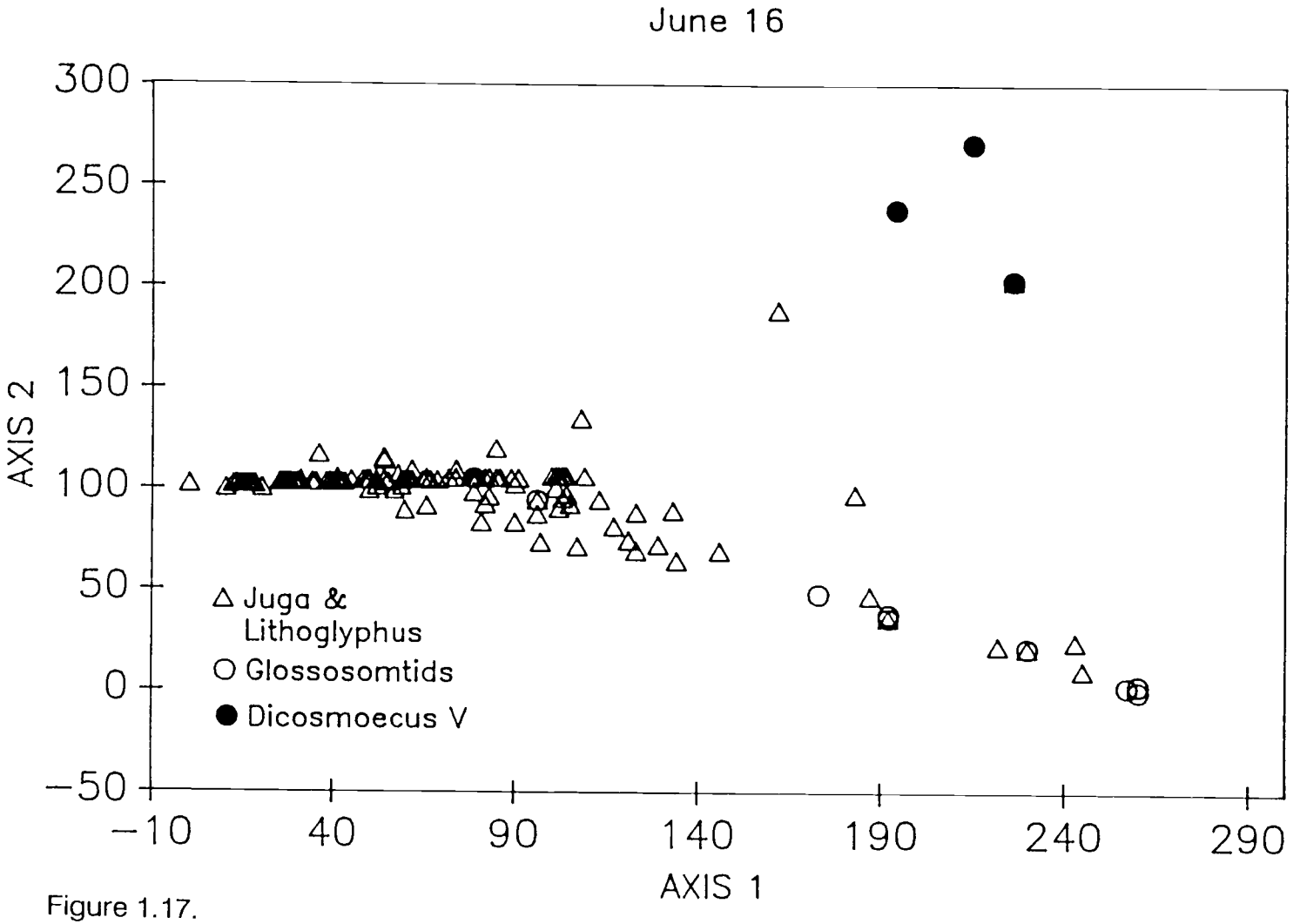

June 16
300
250
200
150
100
50
0
−50
AXIS 2
−10
40
90
140
190
240
290
AXIS 1
Juga &
Lithoglyphus
Glossosomtids
Dicosmoecus V

Figure 1.17.

eight of these quadrats were comprised of either bedrock or boulders.

Substrate size classes tended to characterize most aggregations separated in DCA, but there were many other sites within the analysis that were composed of bedrock or boulders not included in these aggregations. Electivity indicies for substrate size, based on pooled data for all dates, indicated no preferences by fourth-instar D. gilvipes, and preference for small boulders by fifth-instar larvae. Detrended Correspondence Analysis determined bedrock macrohabitat preferences by D. gilvipes on the basis of sites used exclusively by particular taxa and on distribution for particular days. Analysis by both DCA and contiguous patch widths used data for particular days, and both techniques helped determine patterns of macrohabitat use.

Discussion

An organism's response to available habitat can be defined on two ecological scales: 1) microhabitats comprised of physical, chemical and biological variables influencing allocation of an individual's time and energy within its home range and 2) macrohabitat corresponding to that minimal space within which an average individual performs all its biological functions (Morris 1987). In my study microhabitat variables were examined in 0.25-m^2 quadrats, and macrohabitats were suggested by patterns of continuous distribution over larger areas than sample quadrats. These macrohabitats were patches defined by organism use (sensu Pringle et al. 1988). Macrohabitat size varied among herbivore taxa possibly because of varying feeding habits, microhabitat preferences, mobility, and life histories.

Visual enumeration was a practical technique for measuring biotic abundances of snails and scraper caddisflies on a microhabitat scale, but sometimes this method was restricted by stream flow. High stream velocities limited measurements on March 20 and April 10; abundances of third-instar Dicosmoecus gilvipes were high in areas where the stream was accessible ($\bar{x}$ = 10.2 larvae/m^2). On April 22 abundances of third- and fourth-instar larvae were averaged across two complete transects, including empty quadrats.

These two transects were separated by only six meters, and the sample was probably not representative of the entire 50 m reach, in contrast to the collection made on May 14, that included five complete transects. These sampling problems help explain the unexpected decrease in Dicosmoecus larvae on April 22, followed by higher numbers on May 14 and May 28 (Table 1.2). Proportions of fourth-instar larvae from visual counts were higher than those of either third- or fifth-instar larvae on both May dates; though fourth-instar larvae also were numerous in counts made for determining instars, the relative proportion of fourth-instar larvae on May 14 was higher than those counted visually in the stream survey. Perhaps patchy distribution, in combination with error in distinguishing visually between fourth- and fifth-instar larvae, resulted in relatively high numbers of fifth-instar larvae on May 14 ($2.1/m^2$) in comparison to May 28 ($0.12/m^2$).

Dicosmoecus gilvipes development at Big Elk Creek in spring 1986 occurred at a slower rate than among populations studied at the same stream in 1982, when most larvae were in the fifth instar by mid-May (Weissman 1987). Weismman's study, that included three years data, suggested that the timing of high-water spates determined developmental rates. Heavy storms were recorded in Western Oregon during late February 1986, and constant rainfall occurred in early May. High water flows probably slowed development of D. gilvipes so that all larvae did not reach the fifth instar until mid-June during my study.

Dicosmoecus gilvipes in other western streams have been found in deep pools (Hart & Resh 1980) and predominantly on cobble (Hauer & Stanford 1978, Lamberti & Resh 1979). At Big Elk Creek D. gilvipes aggregated on bedrock. In all these streams movement to mid-channel sites and large mineral substrates presumably increases foraging opportunities for periphyton. The timing of third-instar larval movement from stream margins to mid-channel during mid-April was similar to movements in 1981 and 1982 at the Big Elk (Weissman 1987). My study documented not only this movement

pattern, but also changes in microhabitat and distribution of co-occuring herbivores.

Snail and caddisfly distribution in the Big Elk may be influenced by feeding habit differences. Dicosmoecus gilvipes has been recognized as a specialist on algae in later-instars, but occasionally utilizes detrital resources (Wiggins and Richardson 1982, Lamberti and Resh 1979). Early-instars, occupying grassy stream margins, have been presumed to be shredders (Wisseman 1987). However larvae reared on conditioned alder leaves in our laboratory required an algal diet in order to molt from first- to second-instar larvae (personal observation). Third-, fourth-, and fifth-instar D. gilvipes, in patches up to 6 m wide, were distributed across mid-stream bedrock or small boulders at Big Elk Creek, with good exposure to solar radiation; these sites were likely sources of abundant algae (Hawkins et al. 1982, Minshall 1984).

Juga and Lithoglyphus are more flexible in feeding habit than are D. gilvipes. These snails consume both algal and detrital resources to survive late autumn and winter conditions (Hawkins and Furnish 1987). Both snails and glossosomatids also occur in shaded canopy sites where algae is less abundant than in open sites (Anderson and Bourne 1974, Hawkins and Furnish 1987). Snails and glossosomatid caddisflies, which consume a wider range of food types than do D. gilvipes, were not limited to habitat with abundant algae, and were distributed widely across the stream.

Suitability of stream habitat includes not only resource availability but also favorable flow regimes and possibly substrates. Herbivore ability to forage in high velocities may have been controlled by mobility (sensu Townsend 1989). Early-instar Dicosmoecus were confined to stream margins, but fourth- and fifth-instar larvae were found predominantly in deeper mid-channel sites, often on bedrock or small boulders. Highest Dicosmoecus crawling rates measured at the Big Elk (1.8 cm/min) were comparable to rates measured by time-lapse photography in in laboratory streams (1.0-8.6 cm/min, Li and Gregory, in preparation). Juga can move at similar rates (1.8 to 8.8 cm/min in

our laboratory streams), but snails did not occur on some of the bedrock patches preferred by D. gilvipes. Average velocities where snails occurred were lower than those where later-instar D. gilvipes were found; stream hydraulics (e.g., turbulence or velocity) may have limited movement into some habitats such as bedrock or riffles. Glossosomatid caddisflies, that move more slowly than other herbivores in this study (personal observation), generally avoided bedrock, a trend revealed by electivity indices. However glossomatids were able to cope with higher velocities than snails on June 16. Ability to cling to substrates, rather than mobility, probably influences glossomatid distribution.

Another study of Dicosmoecus gilvipes also described random larval distribution within substrate ribbons, with contagious distribution in larger pool macrohabitats (Lamberti and Resh 1979). Similiarly, our study revealed that Dicosmoecus distribution on a larger, macrohabitat scale was contagious, i.e., aggregated on bedrock and small boulder macrohabitats. Snail distribution patterns were less well defined, and snails showed no preference for particular substrates. Macrohabitat patches were described by examining information from particular days. Changing habitat use, associated with developmental changes in herbivores or seasonal changes in the stream environment, was best understood by comparing distributions between sampling days, rather than averaging data over the entire sampling period.

Emphasis in this study has focused on grazer distributions with respect to herbivore behavior and physical factors, but predation potentially could have influenced distribution as well. Water ouzels (Cinclus mexicanus), which have been observed feeding on Dicosmoecus (Jacoby 1987), were seen regularly at Big Elk Creek. Dicosmoecus in the exposed bedrock site would have been quite vulnerable to this source of predation. Predation may account in part for the decreased Dicosmoecus abundances in May after caddisflies moved to mid-stream habitats.

Differing life history patterns also may have played a role in feeding

strategies. Snails live several years with an indeterminate life history (Hawkins and Furnish 1987). The snails may have encountered less nutritious food patches while broadly sampling the habitat. This strategy may be feasible for animals with an indeterminate life history because time required for sufficient growth to reproduce is not seasonally restricted. Caddisflies, with determinate life histories, are constrained by time needed to accumulate sufficient biomass to successfully reproduce within their cohort's narrow emergence period. In Big Elk Creek, prepupation occurs for approximately two months, and pupation for another month (Wisseman 1987). Prepupal diapause helps synchornize emergence, but D. gilvipes in coastal Oregon streams are restricted to one season's growth before emergence. Dicosmoecus are more specific than snails in habitat use, and these caddisflies appear to seek out abundant algal resources in mid-stream habitats.

Distribution patterns of herbivores on Big Elk Creek revealed that Dicosmoecus gilvipes, Juga silicula, Lithoglyphus virens, and glossosomatid caddisflies utilized overlapping macrohabitats. Later-instar Dicosmoecus, obligate herbivores, occupied patches of bedrock or small boulder macrohabitats that were smaller than the broader macrohabitat patches of more generalist snails. Food requirements appeared to be major factors in determining where grazers foraged. Flexibility in food selection may expand potential habitat use, as exemplified by snails distributed across the width of the stream. However, snail foraging may have been constrained by stream hydraulics. Physical constraints imposed by the stream, resource availability, and herbivore characteristics such as mobility, developmental stage, feeding habit, and preferences for substrate classes or stream velocity, affect benthic invertebrate distribution. Developmentally-related changes in behavior and species-specific responses to temporal variations in suitable habitat and resource availability, may enhance partitioning of the stream environment among lotic herbivores.

III. BEHAVIORAL CHANGES IN THE HERBIVOROUS CADDISFLY *DICOSMOECUS GILVIPES* (LIMNEPHILIDAE)

Abstract

Changes in behavioral patterns among third-, fourth-, and fifth-instar Dicosmoecus gilvipes were documented by observations of larvae in laboratory aquaria. Activities of these three instars were recorded in a behavioral catalog which included feeding, crawling, resting, case building, and interactions. Time spent in each category varied according to larval instar, hunger level, and type of algae available. Larvae fed one-third of the time. Third-instar larvae fed longer on diatoms, whereas fourth and fifth instars fed longer on filamentous assemblages. Third-instar larvae crawled faster than did other instars, fourth-instars spent the most time case building, and fifth instars rested more than others. Resting and case building were often associated activities. Interactions among individuals were infrequent; neither aggression nor cannibalism were observed. The variety and changes in behavior exhibited by D. gilvipes may affect grazing levels on algal resources and influence possible competitive interactions. Behavioral studies that encompass developmental patterns of organisms provide critical contexts for studies of ecological processes in streams.

Introduction

Studies of stream invertebrate behavior have been primarily anecdotal or have focused on specific processes (Wiley and Kohler 1984). For example, predator-prey interactions (Molles and Pietruszka 1987, Peckarsky 1980, Peckarsky and Dodson 1980) and foraging behavior (Allan et al. 1987, Hildrew and Townsend 1980, Kohler 1984, McShaffrey and McCafferty 1988, Wiley and Kohler 1981) have been examined in great detail for selected taxa. Despite increasing interest in lotic invertebrate behavior, behavioral repertoires for particular species and behavioral differences between instars have been ignored. We developed a catalog for the common caddisfly, Dicosmoecus gilvipes (Hagen) (Trichoptera: Limnephilidae) to provide a context for investigating behavior. This standard ethological technique has not been used in behavioral studies of stream invertebrates prior to our study.

Dicosmoecus gilvipes was chosen because of its large size, widespread distribution, and numerous previous studies. This species is often a component of herbivore assemblages in montane streams of western North America (Anderson 1976a, Wiggins and Richardson 1982). In western Oregon first-instar larvae hatch in midwinter and are active until prepupation in mid-June (Wisseman, 1987); development time in colder climates is prolonged over two years (Hauer and Stanford 1982). Third-, fourth-, and fifth-instar D. gilvipes inhabit bedrock and boulders in coastal Oregon streams where they graze primarily on periphyton. Other populations of this species have been found on cobble or in large pools (Hart 1981, Lamberti and Resh 1979). Unlike other species in the genus which are primarily predators or shredders D. gilvipes are primarily herbivores (Wiggins and Richardson 1982).

The objective of our research was to describe the suite of activities for individual larvae of D. gilvipes and to quantify behavioral changes during larval development. Responses to different algal assemblages were examined because changes in development may influence foraging behavior. Experimental design incorporated replicate treatments of algal assemblages and instars to provide statistically comparable observations. Rather than

focusing on a specific behavior, we included all behaviors in a catalog that provided the basis for comparisons among instars.

Methods

In April 1985, third-instar larvae were obtained from Big Elk Creek of the Yaquina River drainage in the Oregon Coast Range. Fourth- and fifth-instar larvae were collected in July 1985 from Quartz Creek of the McKenzie River drainage in the Oregon Cascade Range. Both streams are fourth-order systems with cobble beds and significant periphyton growth. Before observations began, larvae were acclimated to laboratory conditions for 1 week at 10^{o} C and at light regimes coinciding with natural photoperiods at the time of collection. Larvae were fed boiled kale during acclimation, but were starved 24 hours before being placed on algae.

A behavioral catalog was developed by observing larvae once every 24 hrs for 2 weeks. Larvae were fed algae and kept in aerated 1-L aquaria at 10^{o}C. Caddisflies were observed immediately after algae on tiles were introduced (Period 1) and 24 hr later (Period 2). All observations were made during daylight between 0700 and 1900. One set of third-instar larvae were observed in April, and another in May. Fourth- and fifth-instar larvae were observed in July.

Observations of the first set of third-instar larvae focussed continuously on an individual larva for 20-75 minutes, a technique referred to as focal animal observation (Altmann 1974). For the second group of third instars as well as fourth-, and fifth-instar larvae, behavior was recorded at 15-min intervals for at least one, and up to four hours; six larvae were observed simultaneously. The latter technique, termed scan sampling, was appropriate for the nonsocial behavior exhibited (Altmann 1974). Eighty-nine behavioral sequences were recorded, involving a total of 69 individuals.

Algal assemblages were cultured on 7.5 x 7.5 cm unglazed tiles in 3-m long recirculating fiberglass streams (see Steinman and McIntire 1986 for

description). Water in each 150-l stream was replaced at a rate of 1.5 l/min. Light energy was provided by sixteen 1000-watt Metalarc lamps (Sylvania Corporation). Dominant algal taxa were determined by scraping a tile with a razor blade, diluting the sample with distilled water to 50 ml, and examining a subsample in a 10-ml settling chamber using a Zeiss inverted microscope.

Light conditions and algal inocula were varied to produce tiles covered with an assemblage dominated either by diatoms or by filamentous green algae. Tiles were selected carefully to provide consistent algal assemblages to specific groups of larvae throughout the observations. Three caddisflies were placed in each aquarium with a specific algal assemblage; five replicates of each algal assemblage were used for instars III-V, resulting in a total of 120 individuals (including two sets of third-instar larvae). Each aquarium contained a layer of coarse sand (approximately 1-2 mm diameter), an aquarium aeration stone, and a small petri dish containing conditioned alder leaves for case building material. Surface area was 0.12 m^2.

Algal assemblages were visually inspected every 24 hours during observations of fourth and fifth instars to provide an estimate of grazing effects. A value was assigned to each grazed tile according to relative algal abundance: 0 = no visible feeding marks, 1 = less than 5 grazing trails, 2 = tile edges grazed, 3 = 50% of tile grazed, 4 = 100% grazed but a thin layer of algae remaining, 5 = 100% grazed and no visible algae. Tiles generally were replaced every 48 hr; 72 hr (from day 8 to 11) and 24 hr (day 13 to 14) intervals also were included.

During initial observations of third-instar larvae, case building activity was estimated by measuring changes in case length. Later, a color-coded, numbered bee tag (2 mm in diameter), was glued to the anterior edge of each third-, fourth-, and fifth-instar case. Case building activity was measured by changes in tag locations. Larvae that died or lost tags (16.6%) were not included in the analysis. Final tag locations among instars and between algal assemblages were compared with a two-way analysis of variance after

transforming data to natural logarithms. Details of particle manipulation during case building were recorded with an MTI-65 video camera. Legstroke frequencies of larvae feeding or crawling were matched to the speed of a metronome; subsequently, metronome rates were converted to strokes per minute.

Behavioral sequences were examined to determine if any activities predisposed larvae to subsequent behavior. Transitions between activities were analyzed with a first-order contingency table. The Chi-square test required that not more than 20 percent of the expected values were five or less (Colgan 1978); therefore, similar acts were consolidated into a table of six categories. Molting activities were useful in developing the overall catalog, but were observed too infrequently to be included in the contingency table. Expected frequencies (for random transitions between acts) were calculated as:

$$m_{i,j} = (\text{row sum}_i \times \text{column sum}_j)/\text{grand sum}$$

A chi-square test compared the observed behavioral transitions with expected frequencies, requiring at least $5R^2$ acts, where R = number of categories, and $10\ R^2$ is optimal (Colgan 1978). Individuals often repeated the same behavior (e.g., continuously feeding during three observations); repeated acts were considered logical zeroes, and only sequences of acts that differed from one another were compared. In our analysis, the 310 acts were well above the minimal $5R^2$ or 180 required.

Relationships between larval instars, algal assemblages, and observation periods, were evaluated with a multiway contingency table (Colgan 1978), and the variables were tested with a likelihood G^2 ratio (Sokal and Rohlf 1981).

Results

D. gilvipes larvae displayed 23 distinct behaviors during over 86 hr of observations (Table 2.1); they either fed or rested in more than half of all

Table 2.1. Catalogued behaviors exhibited by third-, fourth-, and fifth-instar Dicosmoecus gilvipes (total number of acts observed = 535; elapsed observation time = 86 hr, 22 min).

BEHAVIOR	PERCENT OF OBSERVATIONS	
	Individual Activities	Behavioral Category
FEEDING		33.9
Head brushing	14.8	
Head and forelegs feeding	10.7	
Head and all legs feeding	8.4	
RESTING		27.5
No activity, withdrawn into case	27.5	
CRAWLING		17.1
Fast crawling	12.2	
Slow crawling	4.9	
CASE BUILDING AND MAINTENANCE		14.4
Applying silk	1.3	
Manipulating sand	8.6	
Manipulating alder	2.4	
Discarding debris	1.5	
Brushing debris from head	0.6	
Adding gravel and repairing rear of case	0.6	
Breaking off rear of case	0.6	
INTERACTIONS		4.8
Crawling over another larva	2.1	
Rolling over another larva	1.7	
Carrying another larva	0.2	
Clinging to another larva	0.2	
Pushing another larva away	0.2	
Avoiding another larva	0.2	
Fedding on another case	0.2	
MOLTING		1.6
Fastening case to substrate	0.4	
Concealed within temporarily fastened case	0.6	
Shedding exuvia	0.6	

observations. Crawling and case building or maintenance comprised most of the remaining observations (31.5%); interactions and molting were relatively rare. However, the particular behaviors exhibited by third-, fourth-, and fifth-instar D. gilvipes larvae varied significantly (Fig. 2.1).

Feeding

Diatom assemblages consisted of Synedra ulna rosettes and a layer dominated by Achnanthes lanceolata. Filamentous algal assemblages were predominantly Stigeoclonium tenue, though Ulothrix spp., Klebsormidium fluitans and an array of diatoms also were present; diatoms formed an understory beneath the filamentous mat (Steinman and McIntire, 1987).

Larvae brushed, clawed or scraped these assemblages off the substrate before consuming them. The head moved from side to side, or up and down to brush algae. Setae helped collect and retain the algae. Abundant long setae covered the anterior, ventral surfaces of the labrum, and shorter setae occurred on the middle, inner labral surfaces (Fig. 2.2a). On the lower labium and maxillae there also were dense, long setae (Fig. 2.2b). Although fourth-instar larvae are shown in the photographs, similar setae also were observed on other instars of D. gilvipes.

Larvae used either robust mandibles (Fig. 2.2a) or curved tarsal claws of the front and middle legs to scrape periphyton, while hind legs held the larva in place. Legs moved in random sequences when scraping algae, averaging 106 leg strokes/min, with a maximum of 124 strokes/min. A small pile of algae acculmulated as a result of this collecting activity. Strands of filamentous algae were pulled by the front legs toward the mandibles.

Almost all feeding occurred on tiles, but larvae occasionally consumed dislodged algae on sand (Fig. 2.3). All instars responded to fresh algae introduced on new tiles by moving quickly onto tiles and feeding during Period 1 (Fig. 2.3). Most crawling and resting activities occurred on sand. Very little algae was grazed after 24 hr, but algae on tiles were grazed to one-half the

Figure 2.1. Proportion of individuals within each instar (III, IV, V) engaged in six behavioral categories.

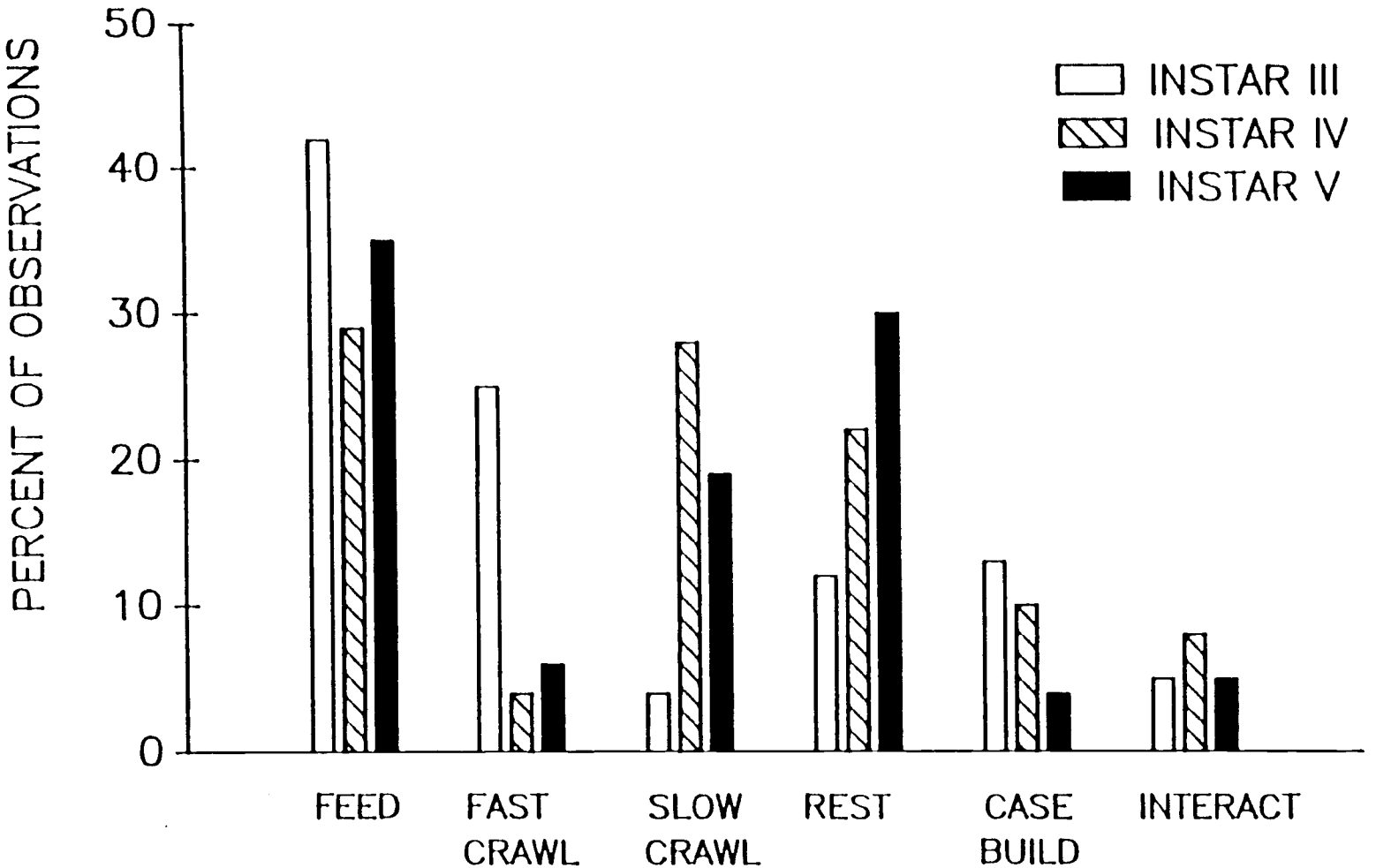

PERCENT OF OBSERVATIONS
50
40
30
20
10
0
INSTAR III
INSTAR IV
INSTAR V
FEED
FAST CRAWL
SLOW CRAWL
REST
CASE BUILD
INTERACT

Figure 2.1.

Figure 2.2. Scanning electron micrographs of fourth instar Dicosmoecus gilvipes mouthparts. Bars denote 100um. 1a: Ventral view of labrum (lr) and mandibles(mn). 1b: Dorsal view of labial palps and labium (lm), silk gland (sg),maxilla (mx), and maxillary palp (mp).

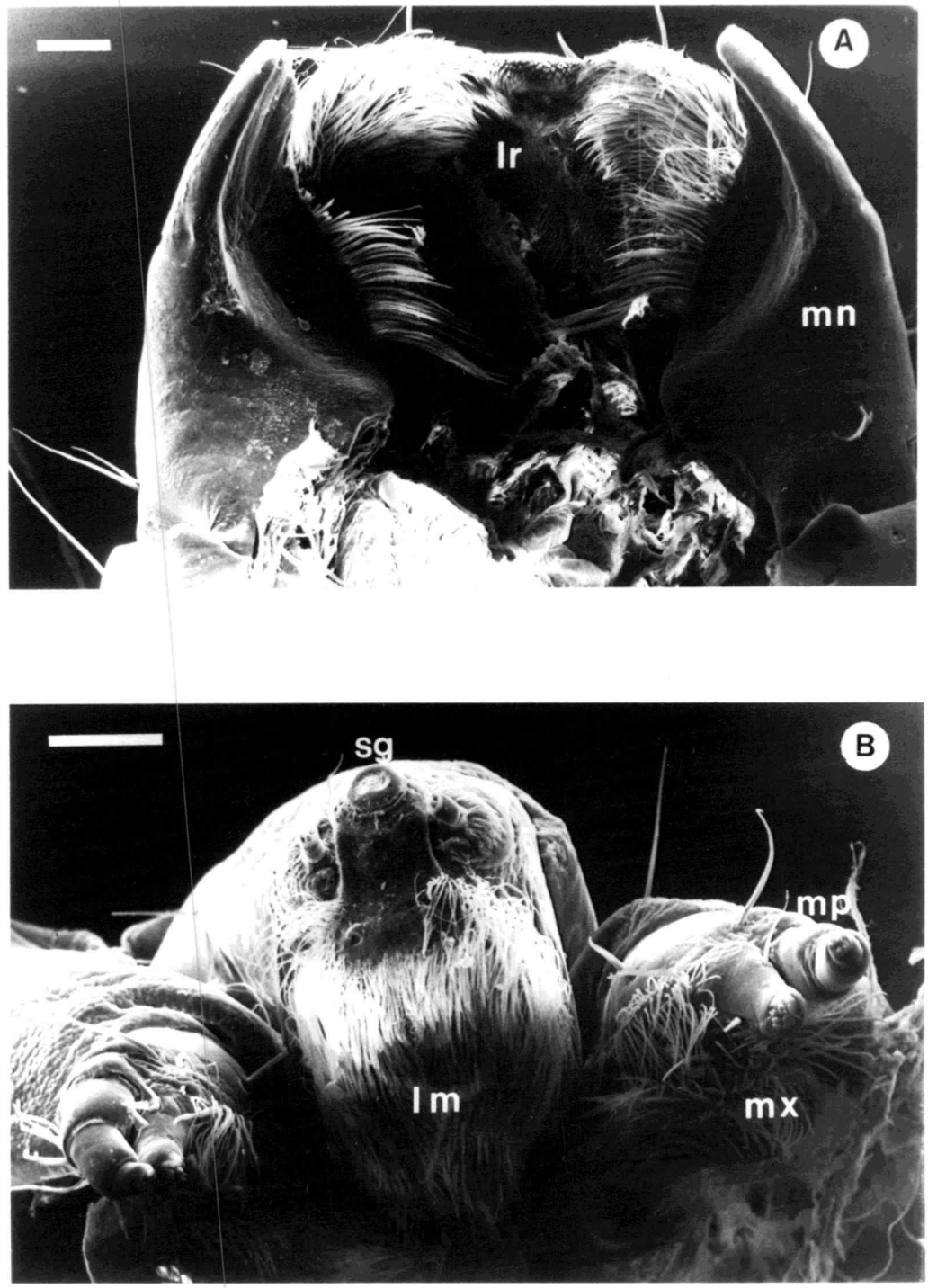


Figure **2.2**

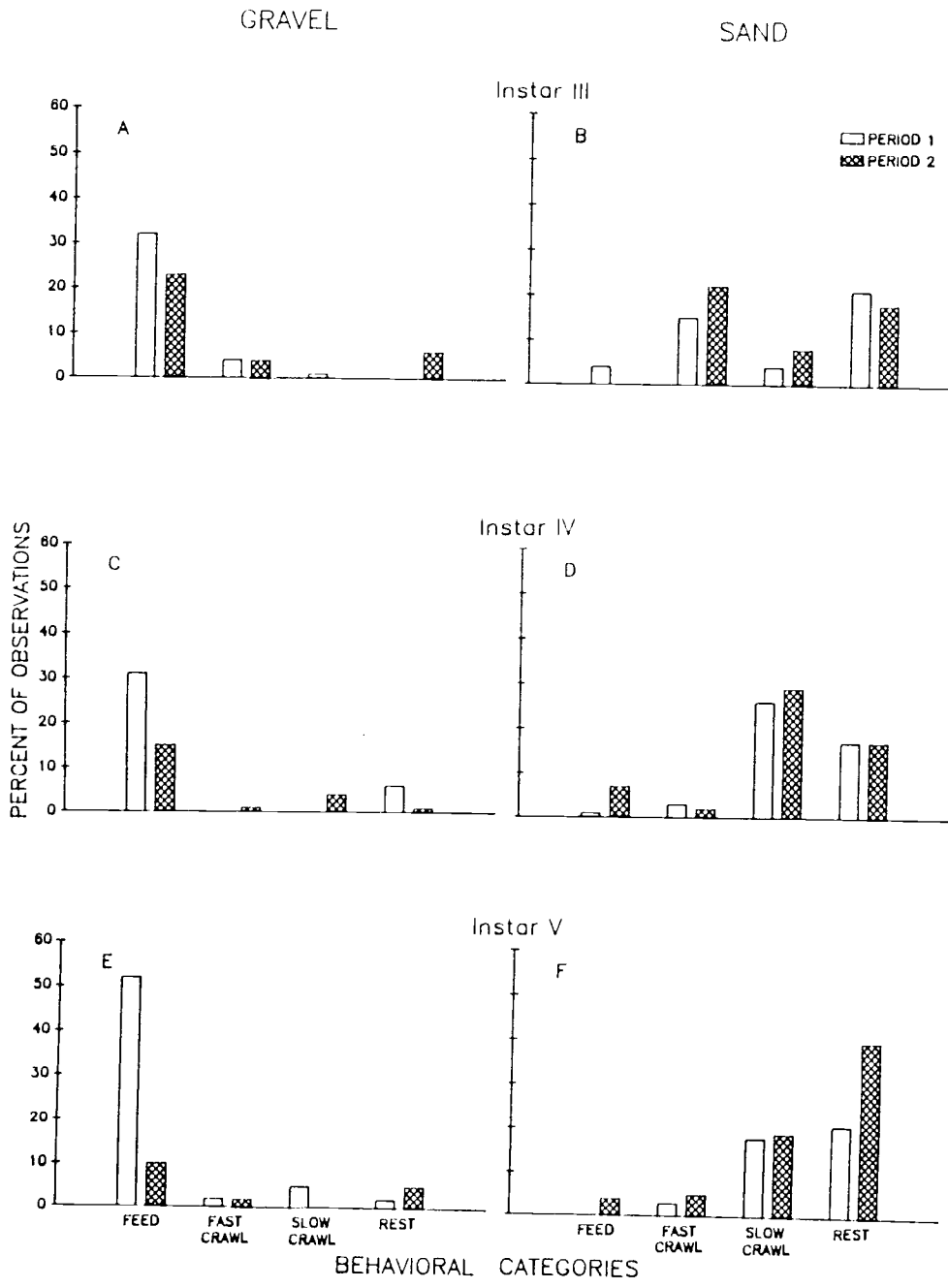


Figure 2.3 Comparison of feeding, crawling and resting behavior on tiles with algae vs. coarse sand for each instar at observation periods 1 and 2. A: Instar III, tile; B: Instar III,sand; C: Instar IV, tile; D: Instar IV, sand; E: Instar V, tile; F: Instar V, sand.

original abundance after 48 hr (Table 2.2). After 72 hr, only thin layers of algae remained.

Each instar exhibited significantly different behaviors in Periods 1 and 2 (Fig. 2.4); behavior among instars also differed between the two algal treatments (likelihood G^2, $p<0.001$). During Period 1, third-instar larvae on diatoms spent more time feeding than those on filamentous algae (Fig. 2.4). Conversely, fourth- and fifth-instar larvae on filamentous algal assemblages fed more than those on diatoms. All instars on diatoms fed less during Period 2 than Period 1, but at least 20 percent of those on filamentous algae continued feeding in Period 2. Fifth instars in particular, fed in higher proportions on filamentous assemblages than on diatoms.

Maintenance and Case Building

Case building activities included manipulating sand or alder particles, attaching gravel onto the case either to increase case size or to repair it, and applying silk by brushing the case with the silk gland. At the end of the fourth instar the curved posterior end of the case was broken off. Larvae cleaned their cases by manipulating debris from within the case with mouthparts and forelegs, then discarding the debris by pushing or brushing out the mass. Both case cleaning and brushing the head with forelegs to remove bits of debris were classified as maintenance activities. On May 3, third-instar larvae built cases of 85% sand and 15% alder. One week later, even more sand had been included (92%), and by the fourth-instar, cases were made entirely of sand.

The proportion of time spent case building (Fig. 2.1, 2.4) and changes in case length (Table 2.3) varied among instars. Case building activity and increase in case size were greater among third-instar larvae fed filamentous algae than those fed diatoms (Table 2.3). In contrast, fourth-instar larvae fed diatoms were more active case builders than those fed filamentous algae; tag locations changed by 7.5 mm among those feeding on diatoms, versus only 4.7 mm for larvae feeding on filaments. Differences in case building were

Table 2.2. Ratings of grazing pattern based on visual assessment of tiles (see text for rating scale). Daily means for each instar were calculated for 5 tiles/algal assemblage. Each overall mean represents 30 tiles.

Duration of Tile Exposure (hr)	Instar IV Diatoms	Instar IV Filaments	Instar V Diatoms	Instar V Filaments
24	2.50	1.00	1.75	1.50
48	2.75	3.67	3.67	2.67
48	3.75	2.75	4.25	3.25
48	2.00	1.00	3.50	1.50
48	4.00	3.00	2.00	3.25
72	4.50	3.25	4.50	3.75
Overall Mean	3.30	2.39	3.55	2.65

Figure 2.4. Comparison of Dicosmoecus gilvipes instar responses to algal introduction and algal assemblages. Instar III: A and B; Instar IV: C and D; Instar V: E and F. Row 1: Period one, algae introduced; Row 2: 24 h after algae introduced.

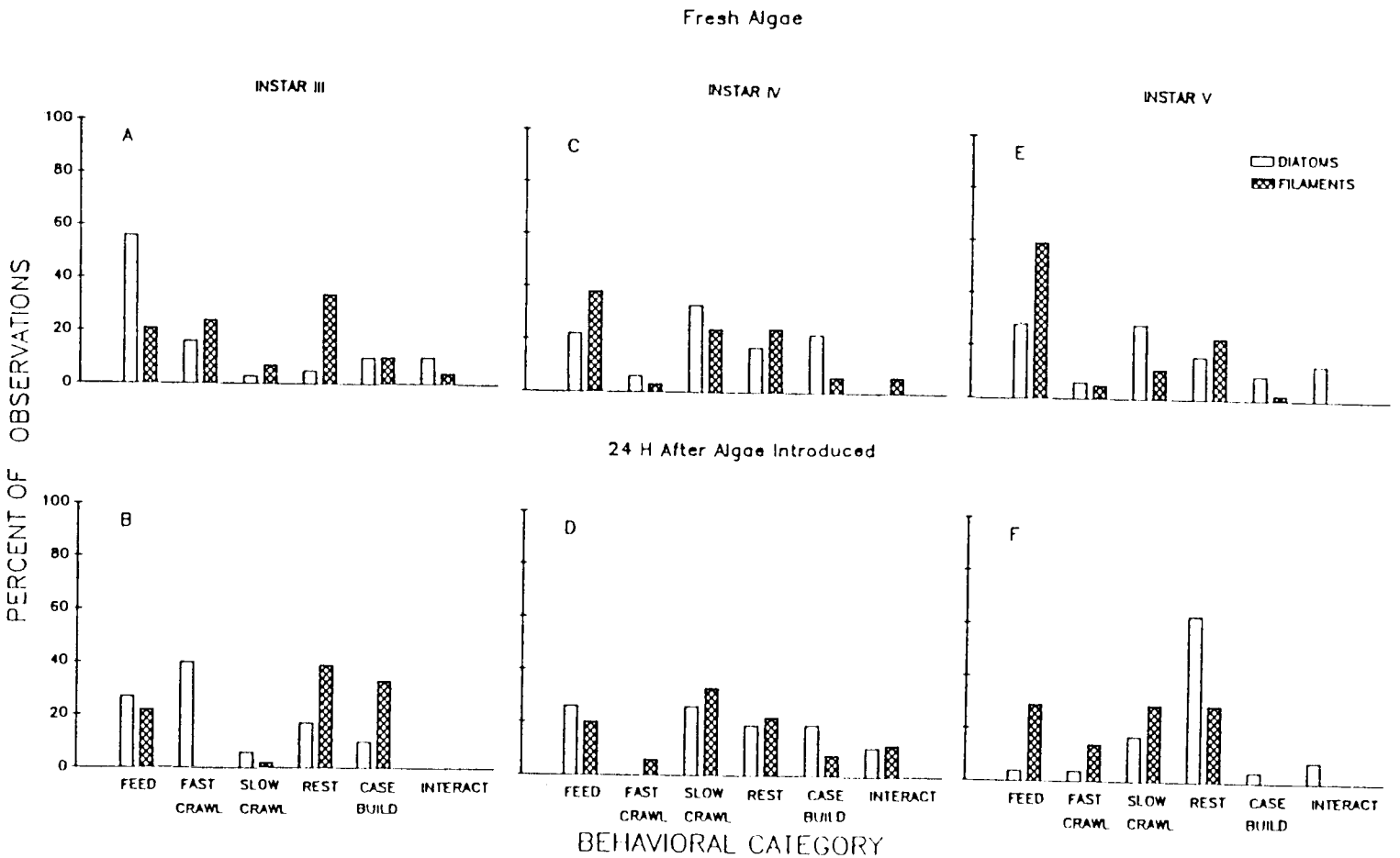

Fresh Algae
INSTAR III
INSTAR IV
INSTAR V
A
C
E
B
D
F
DIATOMS
FILAMENTS
PERCENT OF OBSERVATIONS
100
80
60
40
20
0
24 H After Algae Introduced
FEED
FAST CRAWL
SLOW CRAWL
REST
CASE BUILD
INTERACT
BEHAVIORAL CATEGORY

Figure 2.4.

Table 2.3. Measures of case building: changes in mean case widths, lengths and in location of bee tag labels. Subscripts: 1 = beginning of observations, 2 = after 2 weeks. Measurements are given in mm. Differences between instars and instar x algae interaction were significant ($p<0.05$).

Instar	n	Algae	Mean Width	Mean $Length_1$	Mean $Length_2$	Mean Length Change	Mean Change in Tag Position
III	27	Diatom	-	11.7	17.3	5.6	-
	13	Filaments	-	12.3	19.2	6.9	-
	7	Diatom	-	-	-	-	4.3
	6	Filaments	-	-	-	-	7.3
IV	10	Diatom	5.1	19.5	20.9	1.4	7.5
	9	Filaments	5.1	20.3	21.5	1.2	4.7
V	9	Diatom	5.9	24.7	24.6	-0.1	2.1
	10	Filaments	5.8	24.2	24.4	0.2	1.0

significant between algal treatments for all instars, as measured by change in tag location, (ANOVA, $p<0.05$). Fifth-instar cases changed significantly less than cases of fourth-instar larvae (Table 2.3)(ANOVA, $p<0.05$).

Observational data were consistent with changes in case length. Third instars feeding on filamentous assemblages in period 2 were the most active case builders. Fourth instars were moderately active, and fifth instars rarely worked on their cases.

Crawling

In contrast to the unsynchronized leg movements observed during feeding, larvae moved their legs in pairs to crawl, most often a right and a left leg pulling forward at the same time, but occasionally two on one side would move simultaneously. Third instars traveled more quickly than older instars ($\bar{x}$ = 124 leg strokes per min, maximum = 176 per min). Cases made of organic rather than mineral particles may have enhanced the mobility of third-instar larvae. At the "fast" crawling rate, larvae traversed a 7.5 cm (the width of a tile) in less than one minute. Those moving the same distance in more than one minute were identified as "slow" crawlers; fourth- and fifth-instars generally were slow crawlers (Fig. 2.4).

Resting and Molting

Resting behavior was recorded if a larva exhibited no movement and was withdrawn within its case. Third-instar larvae provided with diatoms actively fed or crawled (Fig. 2.4), but many third-instar larvae on filamentous algae rested. Fourth-instar larvae did not exhibit different resting patterns on the two algal assemblages (Fig. 2.4). Fifth-instar larvae responded differently to each algal assemblage. During Period 2, fifth instars, unlike third-instar larvae, tended to crawl on filamentous assemblages, and rest on diatoms.

Molting was a rare event that we observed only for third instars (Table 2.1). In four of seven observations of molting, cases were lightly fastened to the substrate before exuviae were shed and fourth-instar larvae emerged.

Table 2.4. First-order contingency table of transitions between behavior categories (pooled observations for instars III- V). Numbers in each cell (x_{ij}) represent acts that follow in sequence (e.g., $x_{2,1}$ indicates acts of fast crawling followed by feeding). Single underlines = transitions significantly less than from expected, double underlines = transitions significantly more than expected ($p < 0.05$) based on Chi-square goodness of fit (see text for details).

PRECEDING ACTS	FOLLOWING ACTS					
	Feed	Fast Crawl	Slow Crawl	Rest	Case Build	Interact
Feed	---	20	19	20	11	4
Fast Crawl	13	---	5	10	12	18
Slow Crawl	20	7	---	9	7	12
Rest	22	2	7	---	16	2
Casebuild	14	8	8	13	---	6
Interact	3	4	12	3	4	---

Fastening was not observed for the remaining three larvae which molted. Prepupation at the end of the fifth instar was not observed.

Interactions

Larvae interacted infrequently, and encounters were not agonistic. Neither aggression during feeding nor cannibalism was observed. When two larvae contacted each other, one would roll over, push away from, or avoid the other larva. Competition for case materials was not observed, but partial consumption of another larva's case was observed once. A common interaction among third instars was one animal clinging "piggyback" style to the case of another.

Sequences

Feeding usually was followed by continued searching for food or rest, but generally not followed by case building (Table 2.4). Larvae rarely changed speeds while crawling, but sometimes interacted with other larvae or stopped to build onto their cases. Only slow-crawling larvae stopped to feed. Resting and case building followed each other, and both activities often led to feeding. Interacting larvae generally crawled slowly following such encounters.

Discussion

Differences among D. gilvipes instar activity levels and foraging patterns illustrate the important influence of development on behavior. Morphology and physiology are intrinsic constraints on behavior that change with development (sensu Stephens and Krebs 1986). Changes in mouthpart size and nutritional requirements of D. gilvipes may cause different foraging behaviors as the insect develops. Morphology is an important constraint on feeding dynamics among size-selective benthic consumers; for example, predator size influences the size of prey consumed (Allan et al. 1987, Molles and Pietruszka 1987, Sheldon 1969). Lotic herbivores, on the other hand, encounter a wide array of algal sizes and physiognomies, ranging from single cells and clusters to filamentous mats. Degree of harvest on various algal physiognomies has been

shown to depend on grazer size and mode of feeding (Catteneo and Kalff 1986; Lamberti et al. 1987). My study demonstrates that herbivore development also influences foraging behavior on differing algal assemblages. Increased foraging levels on filamentous algae were associated with later instars that are larger in size.

Changes in physiology concomitant with development also could lead to changes in consumer behavior. Previous laboratory and field studies have demonstrated ontogenic changes in nutritional requirements of limnephilid caddisflies. Fifth-instar Clistoronia magnifica (a shredder) require supplements of fatty acids and protein in order to pupate (Anderson 1976b, Cargill et al. 1985, Hanson et al. 1983), and the shredder/detritivore Dicosmoecus atripes adds macroinvertebrates to its diet in the fourth and fifth instar (Gotceitas and Clifford 1983). Changes in behavior such as increased foraging time, exhibited by fifth-instar D. gilvipes feeding on filaments, may coincide with changing requirements in quantity and quality of food.

Behavioral analyses not only suggest physiological phenomena that motivate individuals, but also provide insight into relationships between individuals. Competition is a potential interaction among herbivorous stream invertebrates such as D. gilvipes. Herbivores might compete for algae by disrupting each other, as observed among black fly larvae (Wiley and Kohler 1981). Alternatively, exploitative competition might occur when algae are made unavailable to other consumers through harvesting activities (Hart 1981).

Behavior exhibited during our study provided no evidence for interference competition or aggression when algal resources were abundant. Densities during our observations ($25/m^2$) were slightly higher than peak densities in streams where the larvae were collected ($20/m^2$), but lower than densities in other streams (Hart and Resh, 1980; Lamberti and Resh 1979). Despite limited space for movement in our experimental aquaria, larvae rarely interacted and showed no agonistic behavior.

The potential for exploitative competition increases as D. gilvipes become fifth instars, when they require more food and can deplete algal resources more quickly than do younger larvae. Fifth-instar Dicosmoecus gilvipes in high densities ($200/m^2$) can greatly decrease benthic algal abundances (Lamberti et al. 1987). Both increased nutritional demands and subsequent higher foraging rates during the fifth instar tend to reduce algal abundances and could lead to increased competitive effects.

The impact of Dicosmoecus gilvipes on the stream environment will change seasonally because behavioral repertoires vary between instars. Among younger instars who spend more time case building, distribution will be determined partly by availability of appropriate organic or mineral materials. Choice of microhabitat also will be influenced by patchily distributed periphyton. Caddisfly activities will be localized according to resource availability. Distributions will change hourly or daily as resources are depleted and larvae move to find new patches. Variations in mobility that occur during larval development also may affect microhabitat selection. Third-instar larvae speeds were faster than those of fourth- and fifth-instar larvae during laboratory observations in this study, but fifth-instar larvae moved faster than other instars at Big Elk Creek under natural flow conditions (see Chapter 1). Fifth-instar larvae were able to move into some mid-channel bedrock macrohabitats where younger larvae did not occur. Mobility within the stream environment depends not only on speed but also agility in the stream current.

Case building becomes less important, and the need for algal resources and potential pupation sites increases during the fifth instar (Gotceitas 1985). Late fifth-instar larvae migrated from mid-stream towards stream banks at Big Elk Creek prior to prepupation (Li and Gregory in preparation). Thus patterns of microhabitat use will change even within the fifth instar.

Differences exhibited among larvae in this study illustrate the importance of observing an organism's full repertoire. Any single behavior occurs within the context of other activities. Unfortunately, previous studies of lotic insect

behavior have examined only particular behaviors in isolation. Techniques such as cataloging, however, quantify observations of a full range of behavior and allow differences between groups (e.g., instars) to be discerned. This inclusive approach to the study of behavior provides a powerful context for ecological investigations. Behavior is an important aspect of stream ecological processes that is integral to a population's use of microhabitat, consumption of resources, and interaction with other organisms. Behavioral studies encompassing broad temporal scales will provide a context for interpreting behavior throughout a benthic organism's life history, particularly the dynamic interaction between consumers and their food resources.

IV. FORAGING BEHAVIOR OF THREE LOTIC HERBIVORES IN LABORATORY STREAMS

Abstract

Time lapse photography and behavioral observations were used to compare foraging behavior of three lotic herbivores during 31-day laboratory experiments. Foraging speed by herbivorous fifth-instar Dicosmoecus gilvipes, a limnephilid caddisfly, and Juga silicula, a pleurocerid snail, decreased after long-term exposure to algal depletion. Foraging patterns of D. gilvipes larvae changed from linear to area-restricted patches with prolonged algal scarcity; J. silcula persisted in linear movements with some retracing. A third herbivore, the mayfly Baetis bicaudatus, foraged in small patches among relatively abundant algae and drifted when algae was less available. Filamentous algal physiognomy prevented linear foraging by Juga. Prolonged exposure to low algal abundances in diatom assemblages resulted in slower snail movements, irrespective of available algal physiognomies (adnate diatoms or matrices of filamentous algae). Morphological variations among these three herbivores differentially constrained speed and area foraged. Snail and caddisfly behavioral strategies shifted from searching wide ranging areas to more restricted patches in response to algal depletion; mayflies increased drifting frequency to expand their search range. Life history and feeding habits of herbivores influences foraging strategies and subsequent risks.

Introduction

Morphology constrains foraging behavior in aquatic consumers. Differences in feeding morphology among stream invertebrates are the basis for functional group classification (Anderson and Cummins 1979, Merritt & Cummins 1980). Lotic herbivores are represented by all functional groups except carnivorous predators, and differ widely in functional morphology and harvesting abilities (Lamberti et al. 1987). Morphology affects not only ingestion during feeding, but also more general aspects of foraging including movements within the stream habitat. The purpose of my study was to compare movement and foraging behavior among three herbivores representing different functional feeding groups.

Algal resources shared by primary consumers in streams occur as relatively continuous patches, in contrast to more discrete distributions of prey items available to carnivorous predators. Algae, like plants in terrestrial systems, are not necessarily discrete items from the grazer's perspective (Stephens & Krebs 1987). Algal growth form, or physiognomy, varies on a microscale among freshwater assemblages (Steinman & McIntire 1986). Unicellular or clustered diatoms and green algae comprise an understory, and filamentous algae dominate an overstory layer. Algal abundance is affected by physical factors such as light (Hawkins et al. 1982, Steinman & McIntire 1986, Sumner & McIntire 1982), and stream velocity (Round 1984), and by biological factors such as grazing by invertebrates (Hunter 1980, Jacoby 1987, Lamberti & Resh 1983, Lamberti et al. 1987, Mayer and Likens 1987) and fish (Cooper 1973, Power and Matthews 1983).

Foraging behavior of particular taxa has been examined previously (Hart 1981, Wiley and Kohler 1980, Kohler 1983, McShaffrey and McCafferty 1988), but behavioral comparisons of different invertebrate herbivores potentially using the same resource have not been made. Three herbivores representing different feeding functional groups and different modes of travel were compared during our observations. The limnephilid caddisfly Dicosmoecus gilvipes feeds

primarily by scraping, and crawls on the substrate with three pairs of legs. The pleurocerid snail Juga silicula rasps its food and glides on a foot aided by secreted mucus. The baetid mayfly Baetis tricaudatus uses mouthparts to gather in its food and either crawls or drifts in the current. These grazers have been identified as key herbivores in western streams (Hawkins and Furnish 1987, Lamberti et al. 1987, Sumner and McIntire 1982), and analogous herbivorous stream invertebrates are found in other regions.

The objectives of my study were to compare foraging patterns of these three lotic herbivores in laboratory streams, to describe changes in movement occurring at different grazer densities, and to determine how long-term exposure to varying algal abundances affects Juga silicula foraging patterns.

Methods

Herbivore Movement Comparisons

Juga silicula were collected from Berry Creek, a third-order stream in the Luckiamute River drainage of the Coast Range of western Oregon. Snails ranging from 10 to 15 mm in length were used in these experiments. Baetis tricaudatus and fourth-instar Dicosmoecus gilvipes were obtained from Quartz Creek, a fourth-order tributary of the McKenzie River in the Oregon Cascade Range. Both streams have cobble bottoms and abundant periphyton.

Invertebrates were placed in recirculating laboratory streams that were 3 m x 0.5 m x 0.2 m deep. Water in each stream was replaced at a rate of 1.5 l/min, and water temperatures were maintained at $14 + 1^{o}$ C. Irradiances of 400 uE m^{-2} s^{-1} were provided by sixteen 1000-watt Metalarc lamps (Sylvania Corporation). Ceramic tiles lining the bottom of the streams were 7.5 x 7.5 cm, and every sixth tile had an upturned, 1-cm high edge. Larger ceramic tiles lined the sidewalls. Five days before the invertebrates were introduced, periphyton was scraped off rocks from four local streams in Benton County, Oregon. Scrapings were homogenized in a Waring blender and brought to a volume of 6 l with water; each stream was inoculated with 1 l of the algal slurry.

Four densities of D. gilvipes (25, 50, 100, and 200/m^2) were used. Experimental densities of 10-15 mm long Juga silicula were determined by estimating equivalent biomasses of the snails and fourth-instar D. gilvipes. Ash-free dry weight for individuals of each taxon was measured. Biomasses for the four densities of caddisflies were 0.75, 1.5, 3.0, and 6.0 g/m^2 ash-free dry mass. Experimental densities of Juga silicula were 65, 125, 250,and 500/m^2; snail biomasses were 0.9, 1.9, 3.8, and 7.5 g/m^2 ash-free dry mass. I will refer to experimental densities as low, low intermediate, high intermediate and high. Low (500/m^2) and high (2000/m^2) densities of B. tricaudatus were used.

Invertebrate movement was recorded with time-lapse photography on days 9, 16 and 31. A photograph was taken every 20 seconds for 15 minutes using a Nikon F3 35mm camera attached to an intervalometer. Negatives of these photographs were projected with a fish-scale reader and maps of individual movements were drawn by tracking individuals in consecutive photographs. Small differences in scale occurred on the photographs as a result of camera positioning over the stream; problems in parallax were corrected by calibrating tile length before digitizing movement on each stream. Distances traversed by individuals, patch areas circumscribed, and angles turned relative to the preceding axis of movement were measured with Sigma-Scan (a digitizing program), and a Hi-Pad digitizer. Patterns were characterized as linear, retracing, or resting. If the grazer moved in a pattern that approximately circled back to the point of origin, the trace was considered a patch.

Over-all mean grazer speeds were compared with a minimum significant difference test (MSD)(Sokal & Rohlf 1981). Statistical testing for differences among days for a given herbivore density was not possible because individuals in the same stream might have been sampled repeatedly on successive days. Distances moved and angles turned by snails and caddisflies at each density were compared for each day using a Kruskal-Wallis One-Way Analysis of Variance. Mayfly movements were analyzed with a Student-Neuman-Keuls

procedure for comparing two samples. Individuals observed for 2 min or more were included in the analysis. If variances were not homogeneous, values were converted to natural logs. Differences between grazer densities on any given day were statistically tested, but grazer densities were not replicated, so differences could not be attributed to density alone.

Effects of long-term algal exposures to Juga foraging

Feeding Observations. Visual observations of individual Juga feeding on three algal assemblages also were made during the previous experiment. Algal assemblages at the time of these observations were dominated by diatoms (particularly Synedra), filamentous green algae (Stigeoclonium) or a mixture of diatoms and tufts of filamentous green algae. Eighteen snails were observed for 5-min intervals on days 24, 25 and 43. A G-test for heterogeneity was used to compare responses to algal morphology (Sokal and Rohlf 1981).

Effects of algal abundance on Juga foraging. Effects of long-term exposure to three levels of algal availability on Juga speed and direction of movement were examined in a separate experiment. Varying algal abundances were developed in streams with equal densities of snails and covered by three densities of plastic screening (Table 3.1). Dominant algal physiognomies corresponded to algal levels; low algal densities were dominated by diatoms, intermediate by a mixed unicellular green and filamentous assemblage, and high densities by filamentous green algae. Snails fed for 30 d in each stream prior to our observations.

Five snails from each stream were marked with dots of non-toxic opaque paint on day 31. Snails were coded by color for prior algal availability and by number of dots to identify individuals. Only low and intermediate algal level streams were used as observation streams because filaments in the high algal abundance streams obscured viewing. Five snails from each algal abundance were placed in these observation streams; records were kept for 90 snails in six streams.

Table 3.1. Mean biomass of algal assemblages in laboratory streams (mean ash-free dry weight in g/m^2).

Grazer	Day	Densities				
		Low	Low Int.	High Int.	High	Control
Dicosmoecus	8	1.17	0.19	0.14	0.10	1.39
	16	2.34	2.34	1.38	0.98	15.48
	32	7.87	3.78	3.28	1.41	43.74
Juga	8	1.52	0.10	0.02	0.14	
	16	15.74	0.40	0.48	0.26	
	32	43.47	20.30	7.41	1.54	
Baetis	8	1.27	0.68			
	16	13.64	5.31			

Locations of identifiable snails in each stream were recorded on maps every 15 min for 3 h. Subsequently, a map of movement was drawn for each individual; distances travelled and angles turned during 3 h were digitized and measured in the digitizing program SigmaScan. At hourly intervals, behaviors of each individual were observed for a 1-min period. Five major behavioral categories were derived from feeding observations in the previous experiment: 1) extend forward, 2) extend and turn, 3) body tuck, 4) change direction, and 5) head movements.

Behavioral differences related to prior stream residence and to conditions in observation streams were compared with a Two-Way Analysis of Variance. Numbers were transformed to natural logarithm for greater homogeneity.

Results

Algal Availability

Algal availabilities were negatively associated with herbivore densities. Algal availability at the beginning of the experiment was much lower at all grazer densities than in the control streams that did not contain herbivores (Table 3.1). Algal biomass remained low in all Dicosmoecus densities. In streams with low density Juga, algal levels were almost as high as the control stream by day 16, but algal biomass associated with other densities developed more slowly. At high snail densities algal abundances remained low.

Herbivore Movement

Grazer responses to different levels of algal abundance included changes in speed and foraging pattern. Caddisfly and snail speed tended to decrease over 31 d (Fig. 3.1, 3.2). Rates of movement were not significantly different between caddisflies and snails on day 8 or day 16. Snails moved faster than caddisflies on day 31 (Fig. 3.3), when variance among snails was low ($p < 0.05$,MSD). Mayflies crawled significantly slower than the other two grazers ($p < 0.01$, MSD).

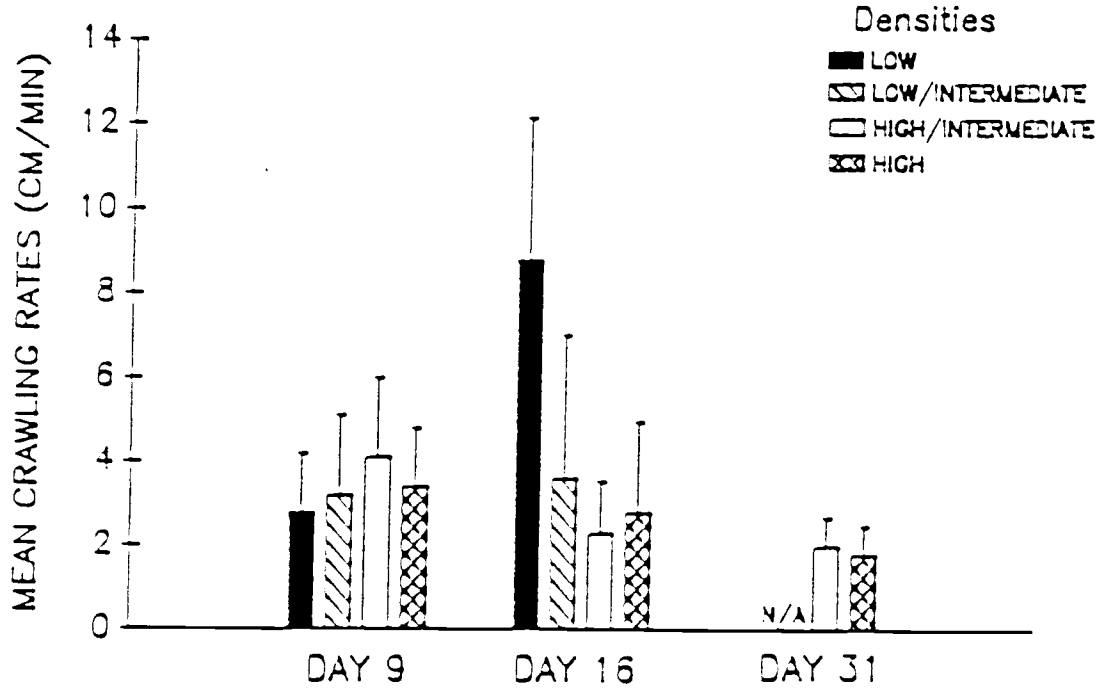


Figure 3.1 Comparison of Juga mean crawling rates at low, low/intermediate, high/intermediate, and high densities on observation days 9, 16, and 31. Error bars are standard deviations.

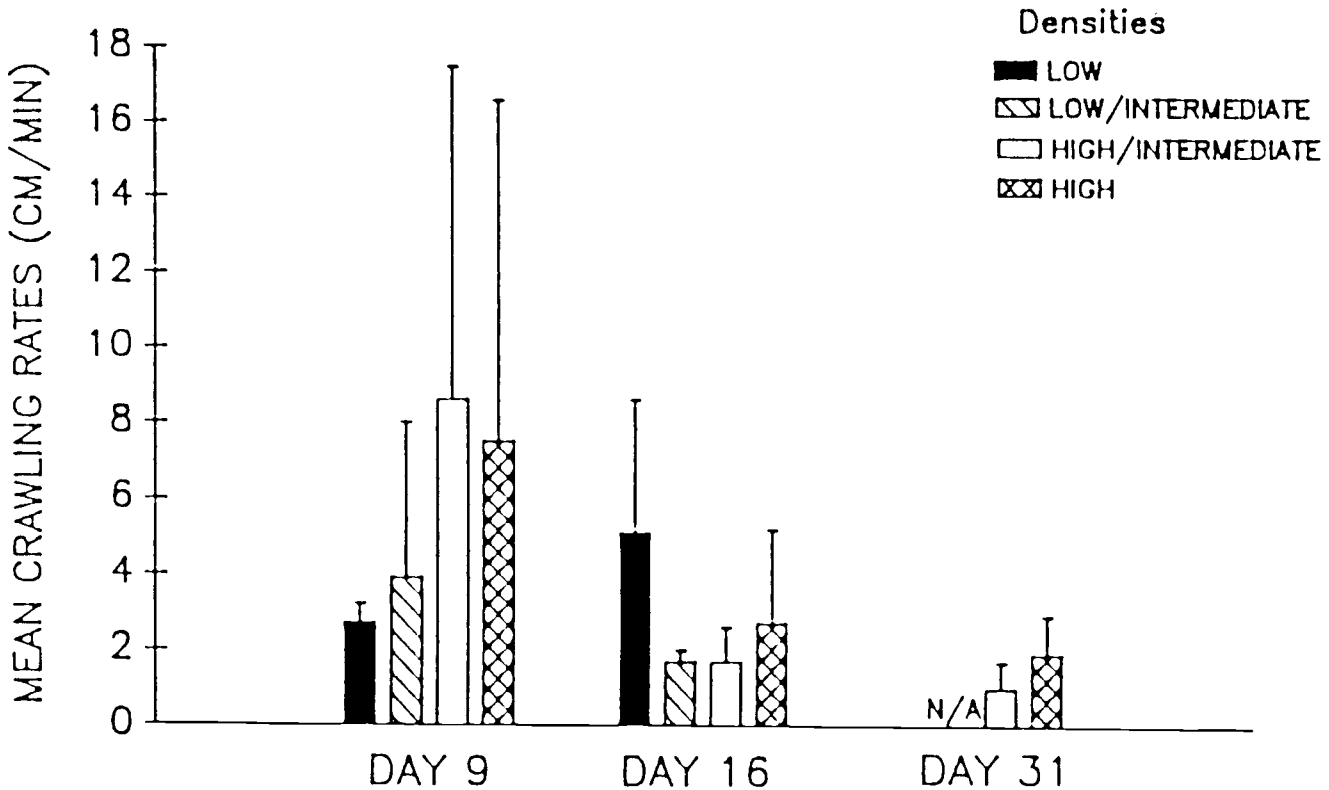


Figure 3.2 Comparison of Dicosmoecus mean crawling rates at low, low/intermediate, high/intermediate, and high densities on observation days 9, 16, and 31. No significant differences between treatments on any day. Error bars are standard deviations.

Figure 3.3. Comparison of mean speeds of Dicosmoecus, Juga, and Baetis on observation observation days 9,16, and 31. Bars denote standard deviations.

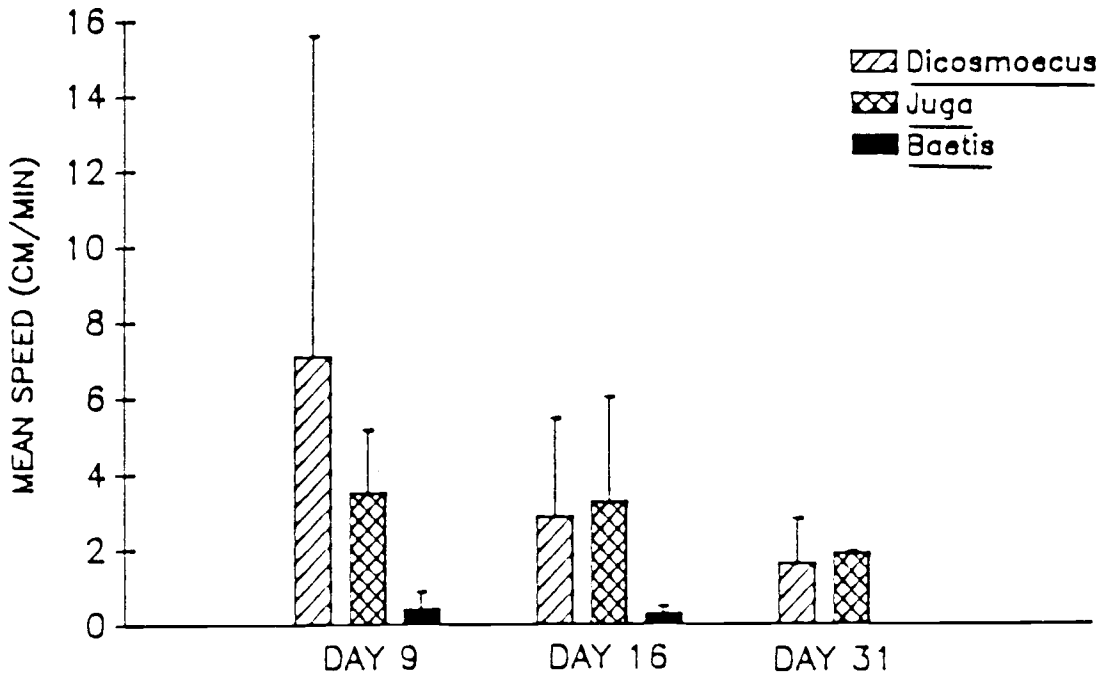

MEAN SPEED (CM/MIN)
16
14
12
10
8
6
4
2
0
DAY 9
DAY 16
DAY 31
Dicosmoecus
Juga
Baetis

Figure 3.3.

Differences in speed among grazers reflected variations in foraging patterns. Maps illustrating movement patterns are records of 15-min time-lapse photography (Fig. 3.4, 3.5, 3.6). Each square in the grid represents a 7.5 cm x 7.5 cm tile. Snails primarily moved in a linear, systematic fashion on day 8 and day 16 (Fig. 3.4). Some snails traced small patches on day 31 (Fig. 3.7). Many caddisflies switched from linear foraging on day 9 to more area-restricted movement by day 16 (Fig. 3.5, 3.8). Caddisfly grazing resulted in lower algal availabilities on day 32 than in other grazer treatments (Table 3.1); caddisflies also were quickest to change foraging patterns under resource-limiting conditions. Dicosmoecus may have traversed less territory than did snails on day 31 because most caddisflies foraged in patches, crossing back over areas previously travelled whereas Juga movement was faster and linear or zigzagging. Many mayflies foraged in patches on both observation days (Fig. 3.6, 3.8).

Effects of herbivore density

Foraging patterns changed in response to different grazer densities and subsequent algal availabilities. Almost all Juga foraged in linear patterns at the beginning of the experiment when algal resources were uniformly low (Fig 3.9). Snails moved most quickly and turned most often in the high/intermediate density on day 9 ($p < 0.05$ ANOVA). Most snails continuing to forage in low algal resources (high density treatment) on day 16 also continued moving in linear patterns, while a larger proportion of snails at lower densities were retracing their tracks (Fig. 3.9a-d). By the end of the experiment the majority of snails at high densities were retracing, whereas 50% of those at high/intermediate densities were moving linearly again (Fig. 3.9c). Speeds of snails at high and high/intermediate densities tended to decrease over the 31-d experiment.

Dicosmoecus initially moved in linear patterns, but most those at high density were foraging in small patches on day 16 (Fig. 3.8, 3.10). Caddisflies at other densities continued linear movements until day 31 when all larvae retraced their movements, foraging in zigzag patterns or patches (Fig. 3.8, 3.10).

Figure 3.4. Examples of Juga movement patterns recorded by time lapse photography on three observation days. Open circles denote starting point for each individual, closed circles represent location at 20-second intervals. Total photography time = 15 min. Each square represents a 7.5 cm x 7.5 cm ceramic tile; tiles with dashed lines had an upturned edge (see text). Maps have been drawn to correct for parallex. Dashed lines for one individual were drawn to distinguish it from nearby individual. A. Day 9;n=11 B. Day 16; n=8 C. Day 31; n=8.

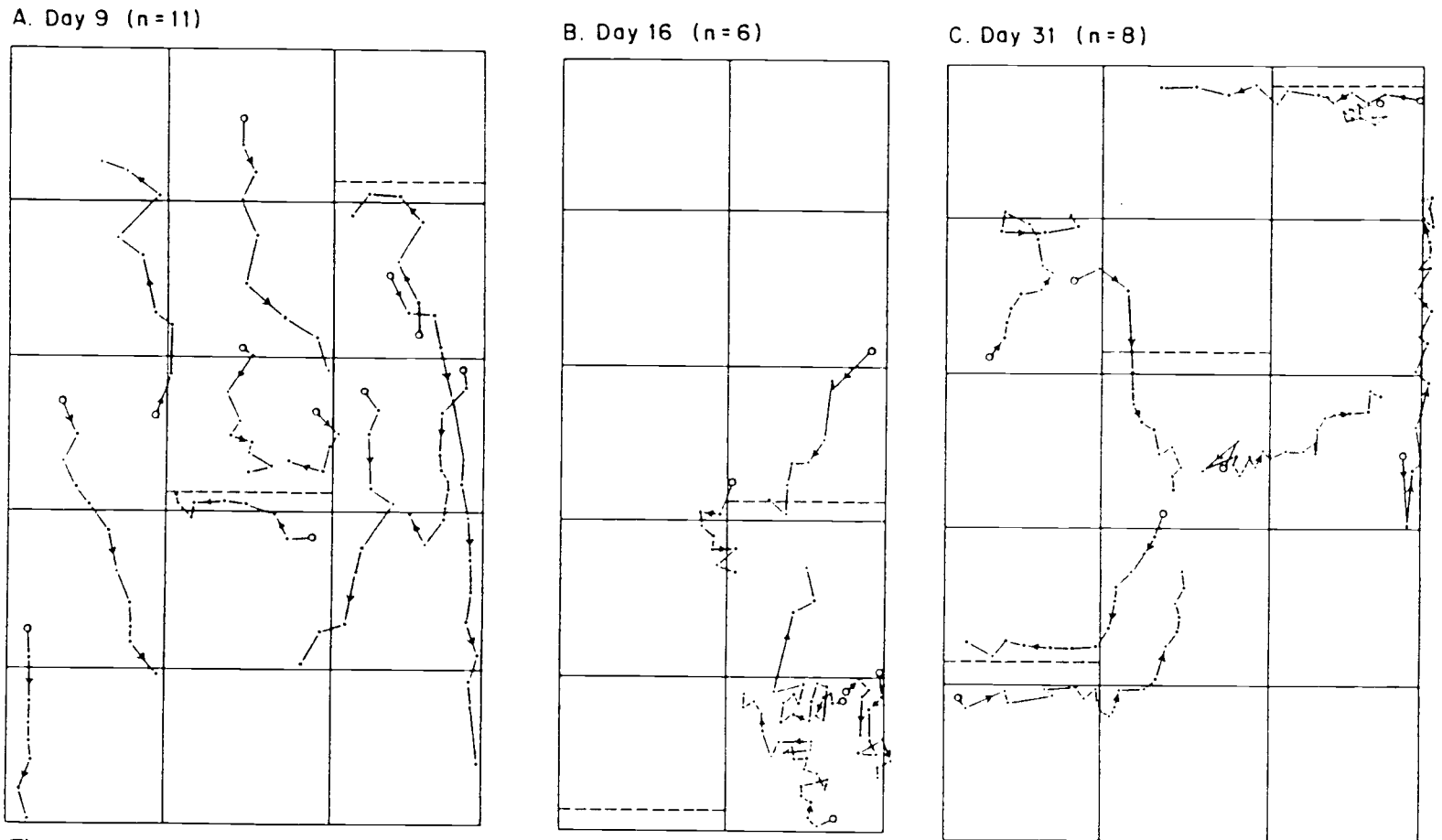


Figure 3.4.

Figure 3.5. Examples of Dicosmoecus movement patterns recorded by time lapse photography on three observation days (see Figure 3.4). Dashed lines have been drawn for one individual to avoid confusion with nearby individual. A. Day 9; n=6 B. Day 16; n=6 C. Day 31; n=3.

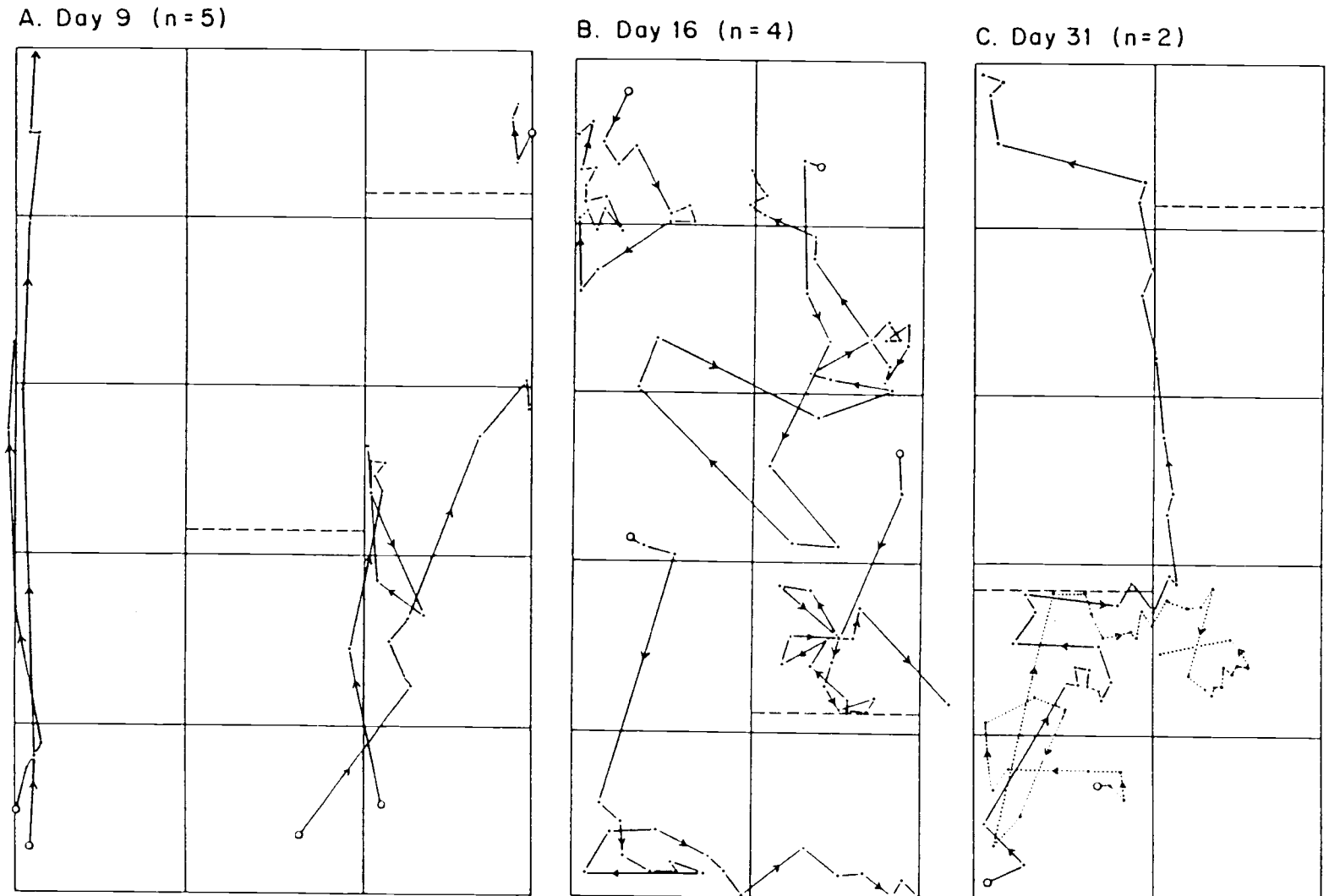
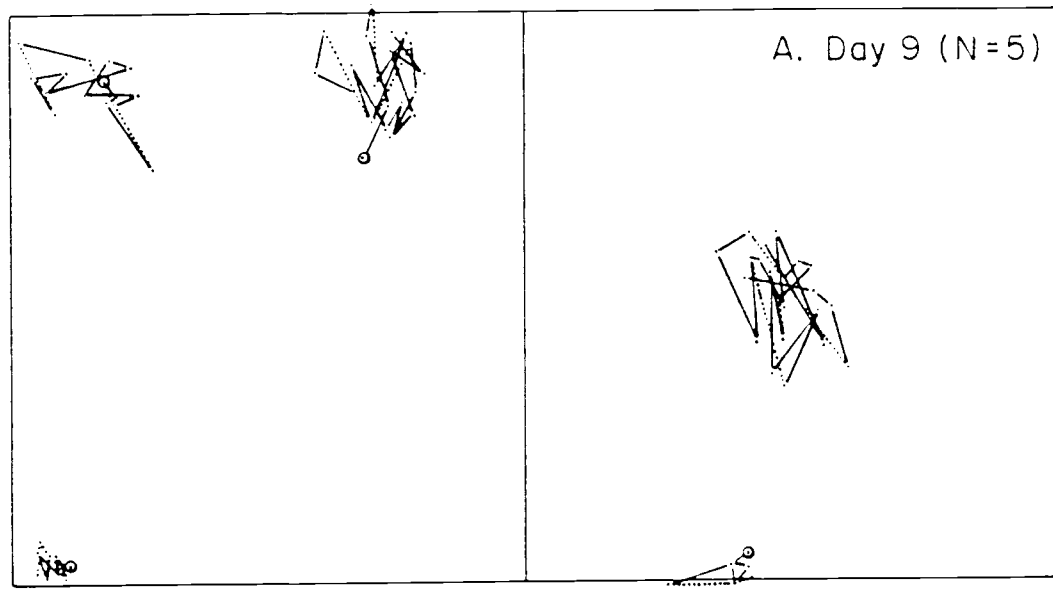


Figure 3.5.

Figure 3.6. Comparison of Baetis foraging patterns on observation days 9 (n = 5) and 16 (n = 4) recorded by time lapse photography. Each square represents a 7.5 cm x 7.5 cm tile.



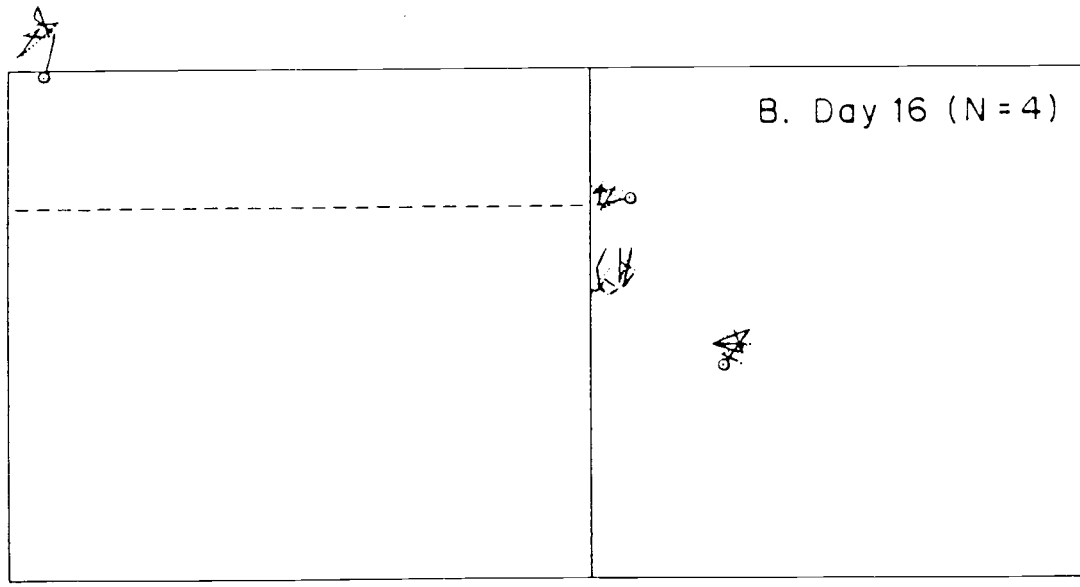


Figure 3.6.

Figure 3.7. Mean patch areas circumscribed by Dicosmoecus, Juga, and Baetis on observation days 9,16, and 31. Bars denote standard deviations.

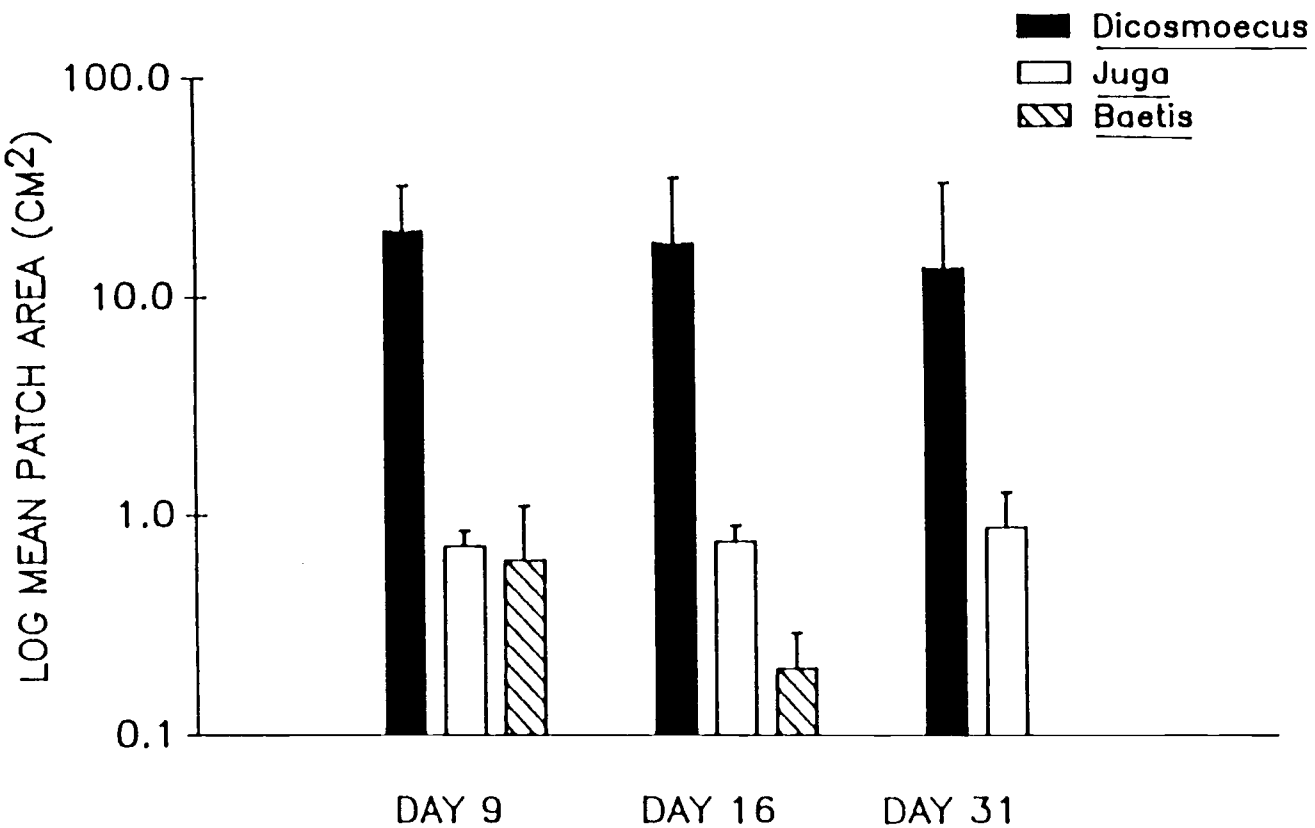


Figure 3.7 Mean patch areas circumscribed by Dicosmoecus, Juga, and Baetis on observation days 9,16, and 31.

Bars denote standard deviations.

Figure 3.8. Proportion of Dicosmoecus, Juga, and Baetis tracing patches on tiles during observation days 9,16, and 31. Movements were considered patches when individuals approximately circled back to the point of origin.

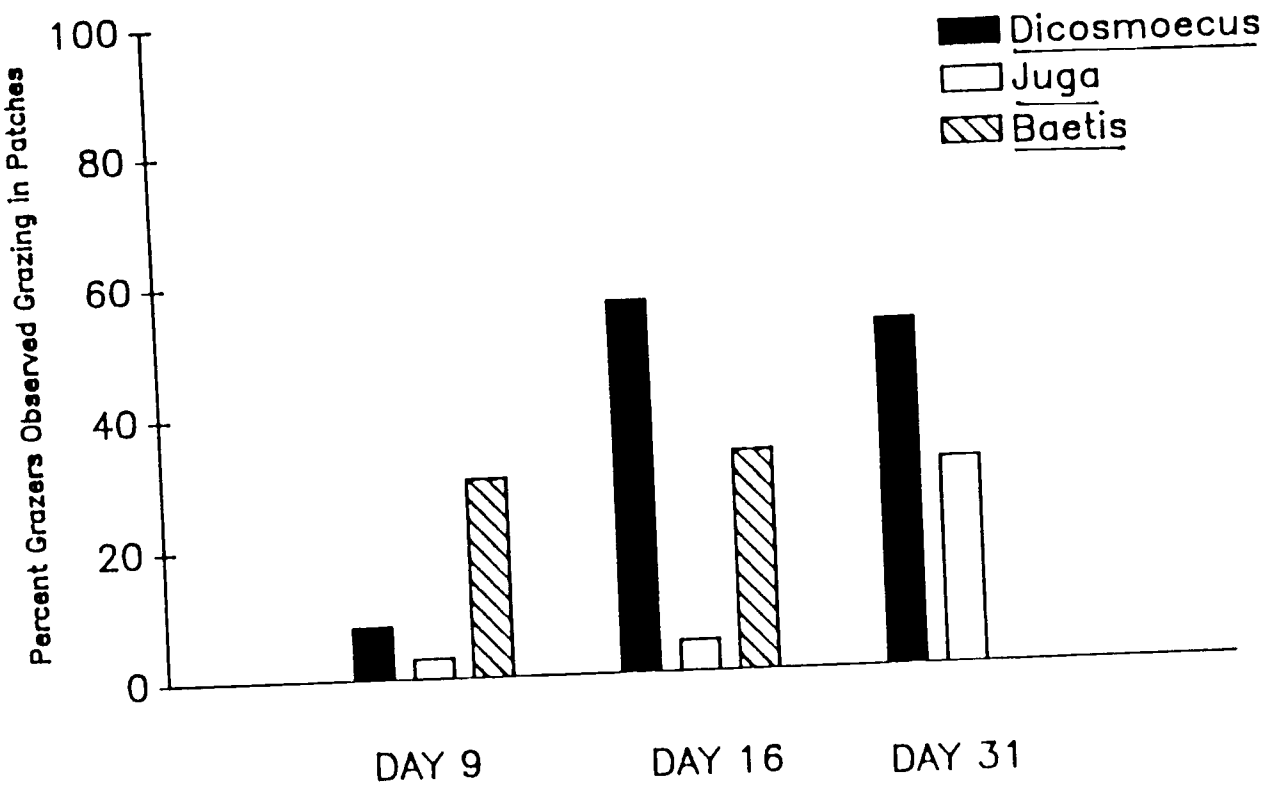


Figure 3.8 Proportion of grazers tracing patches on tiles during observation days 9,16, and 31. Movements were considered patches when individuals approximately circled back to the point of origin.

Figure 3.9. Comparison of Juga exhibiting linear movement, zigzag movement, retracing, and resting patterns at low, low/intermediate, high/intermediate, and high densities of snails. Recorded observations were > 2 min. Zeroes indicate no individuals were observed exhibiting a particular pattern.

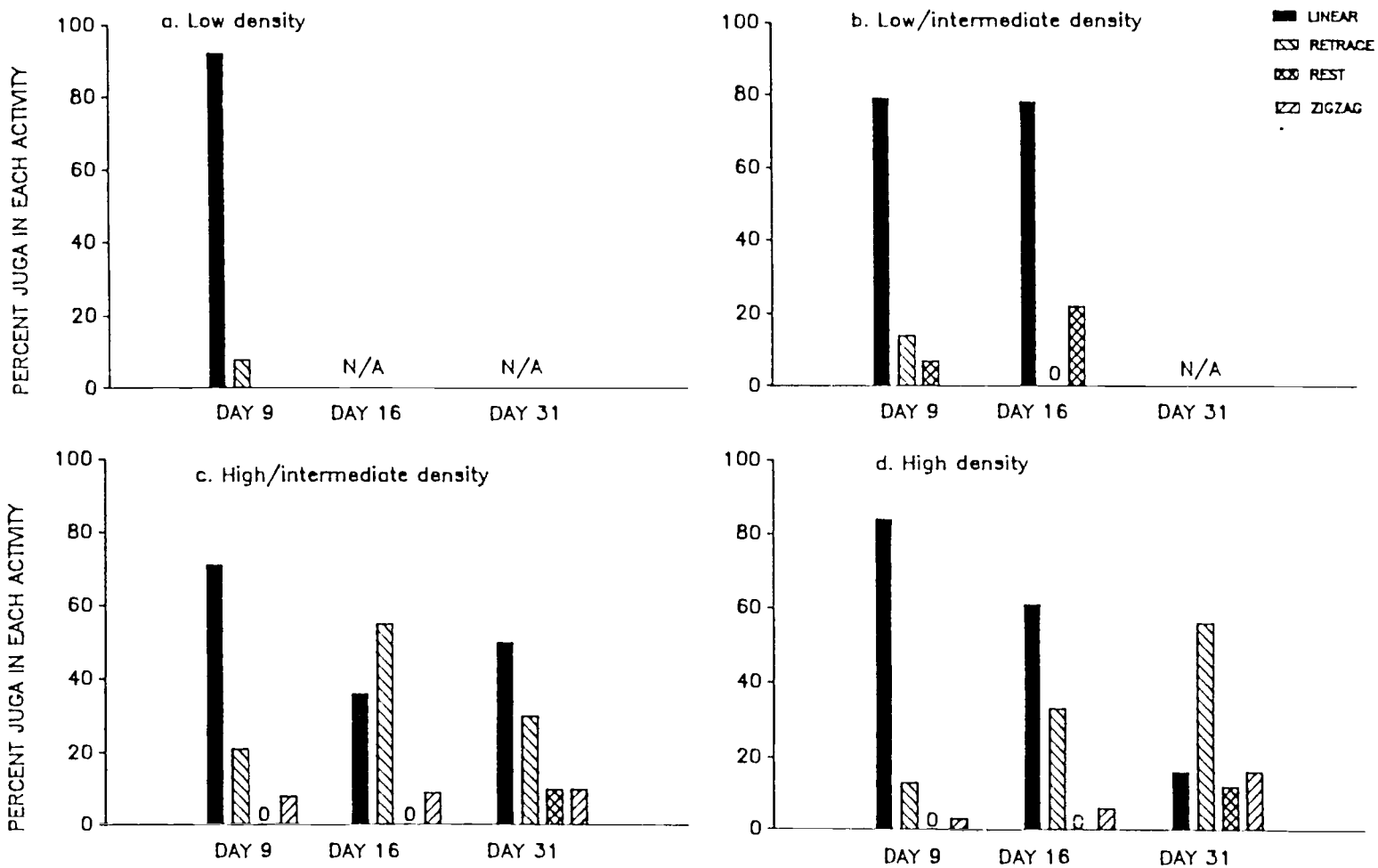

a. Low density
b. Low/intermediate density
c. High/intermediate density
d. High density
PERCENT JUGA IN EACH ACTIVITY
100
80
60
40
20
0
N/A
N/A
0
DAY 9
DAY 16
DAY 31
LINEAR
RETRACE
REST
ZIGZAG

Figure 3.9.

Figure 3.10. Comparison of Dicosmoecus individuals exhibiting linear movement, zigzag movement, and resting patterns at high/intermediate, and high densities of caddisflies. Recorded observations were > 2 min. Zeroes indicate no individuals were observed exhibiting a particular pattern.

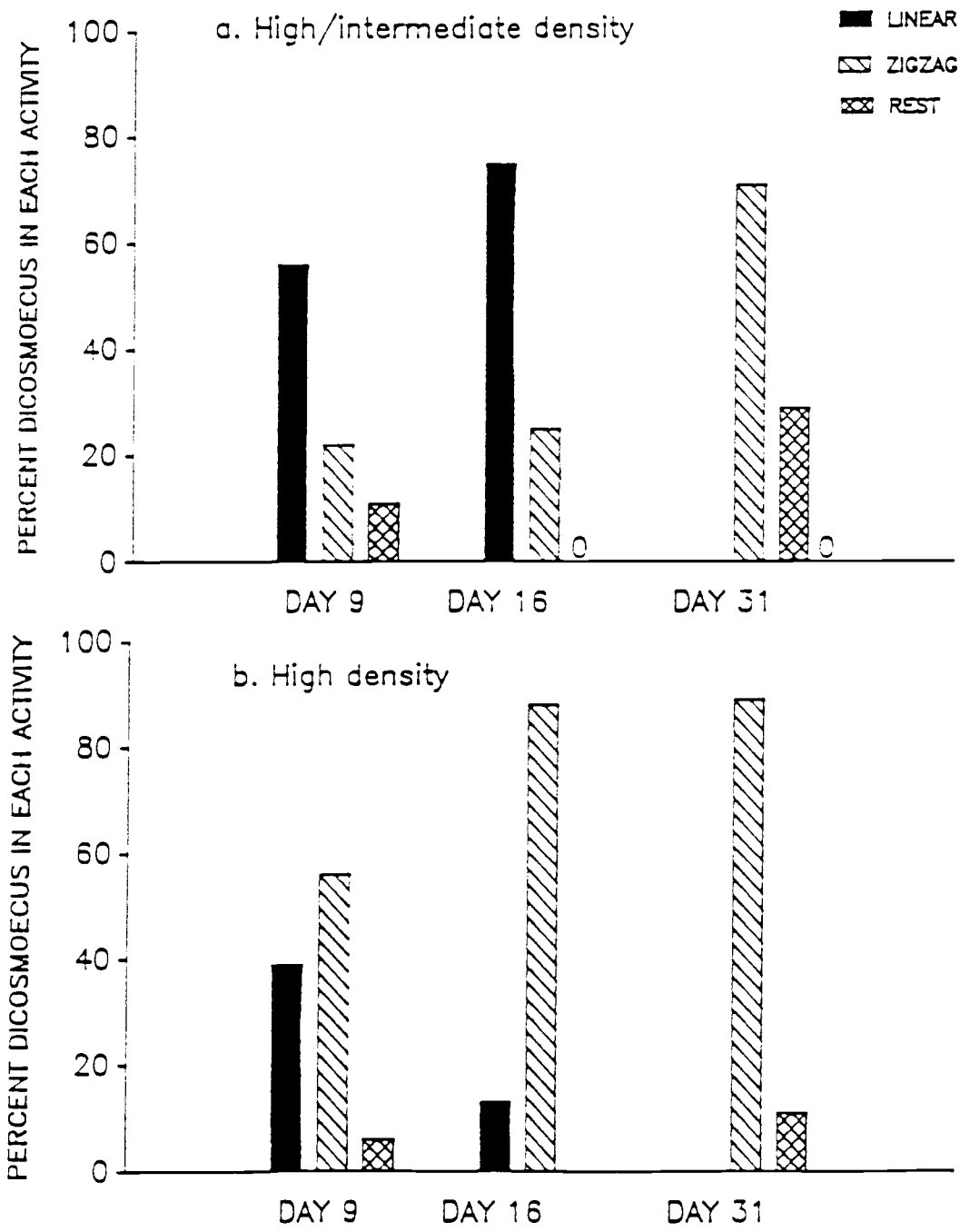

a. High/intermediate density
LINEAR
ZIGZAG
REST
PERCENT DICOSMOECUS IN EACH ACTIVITY
100
80
60
40
20
0
0
0
DAY 9
DAY 16
DAY 31
b. High density
PERCENT DICOSMOECUS IN EACH ACTIVITY
100
80
60
40
20
0
DAY 9
DAY 16
DAY 31

Figure 3.10.

Movement rates on each observation day were highly variable. Neither larval speed nor mean number of angles turned were significantly different among densities on any day ($p < 0.05$, Student-Neuman-Keuls).

Mayfly movements were confined to small patches in all observations (Fig 3.6, 3.7), and crawling in straight lines was not observed. Neither speed nor angles turned were significantly different on any day (Fig. 3.11, Table 3.2). Most mayflies drifted during the 15-min observations in order to move between tiles (Fig 3.12). Larvae either drifted onto a tile and remained, drifted onto and then off a tile, or were observed only drifting off. Mayflies at low density on day 9 drifted and stayed in the same patch in highest proportions; on the same day mayflies drifting on and off the same patch were most numerous in the stream with higher densities.

Observations of Juga Behavior

Five behavioral categories were generalized from observations of Juga: 1)extend/forward, 2)extend/turn, 3)tuck or rest, 4)change direction, and 5)head move (Fig. 3.13). Most of these movements , with the exceptions of tucking and resting, appeared to be associated with feeding. The behaviors seemed to be varying responses to different algal physiognomies. The proportion of snails exhibiting each behavior differed significantly among snails in the three algal assemblages ($G_h = 15.22$, $p<0.05$). Snails in diatom-dominated streams maneuvered easily through the periphyton, extending or changing directions 79% of the time. Those in mixed assemblages extended forward more than snails in other assemblages (Fig. 3.13). Snails in diatom and mixed assemblages were homogeneous in their behavior. Individuals foraging in filamentous algae spent more time waving their heads or antennae, and less time extending or changing directions than other snails. Snails in filamentous and mixed assemblages, which spent more time tucking or resting than those on diatoms, were similar in their behavior as compared to snails on diatoms (Fig. 3.13). Tucking behavior seemed to be an avoidance response to filamentous algae that were waving in the current.

Figure 3.11. Comparison of Baetis crawling rates at low and intermediate densities on observation days 9 and 16 (cm/min).

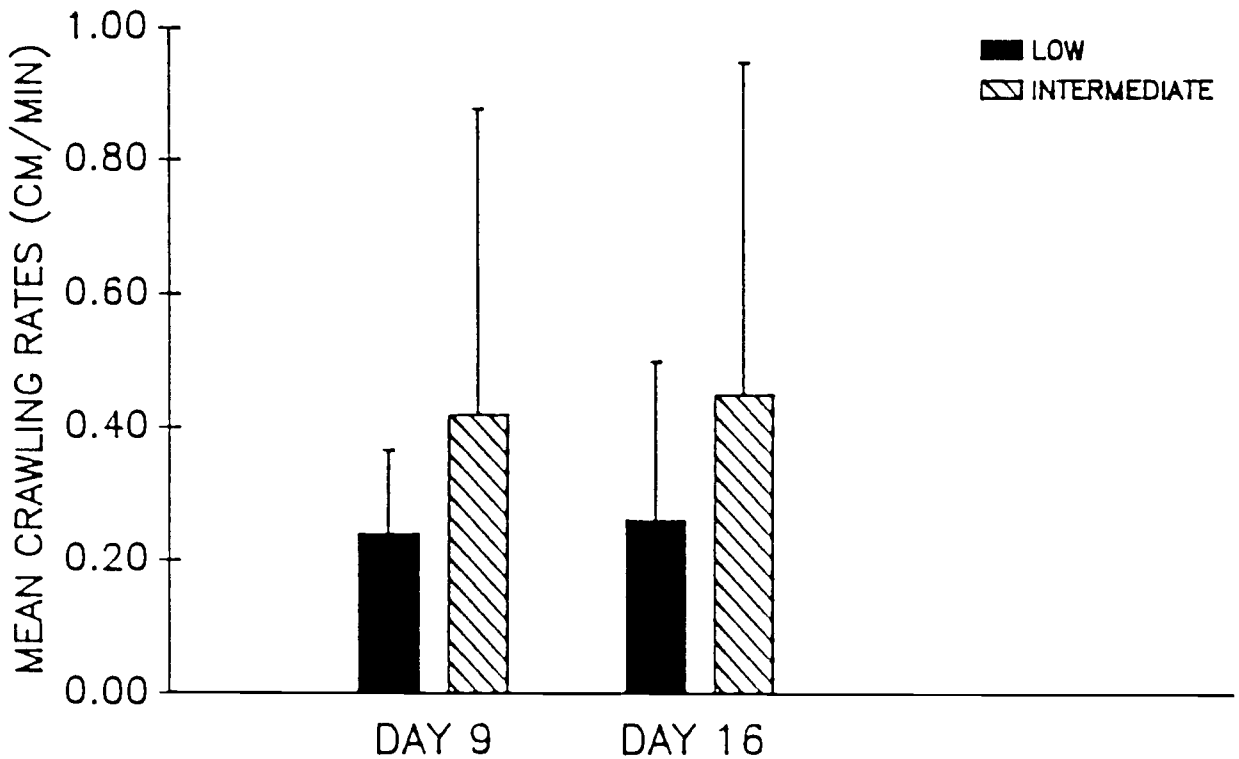

1.00
0.80
0.60
0.40
0.20
0.00
MEAN CRAWLING RATES (CM/MIN)
LOW
INTERMEDIATE
DAY 9
DAY 16

Figure 3.11.

Table 3.2. Mean speed and mean number of angles turned/min by Baetis tricaudatus in streams of differing densities. Numbers in parentheses are standard deviations.

Mayfly density	Day 9	Day 16
	Mean speed of individuals crawling (cm/min	
Low	0.24 (0.12)	0.26 (0.07)
Intermediate	0.42 (0.46)	0.28 (0.20)
	Mean number of angles turned/min	
Low	0.2 (0.2)	0.2 (0.2)
Intermediate	0.5 (0.5)	0.5 (0.8)

Figure 3.12. Proportion of Baetis drifting at low and high densities during 15-min time-lapse photography observations in laboratory streams. Total number of Baetis observed are divided into those which drifted (shaded) and non-drifters (unshaded). Lower numbers on day 16 reflect fewer mayflies in the stream on that date.

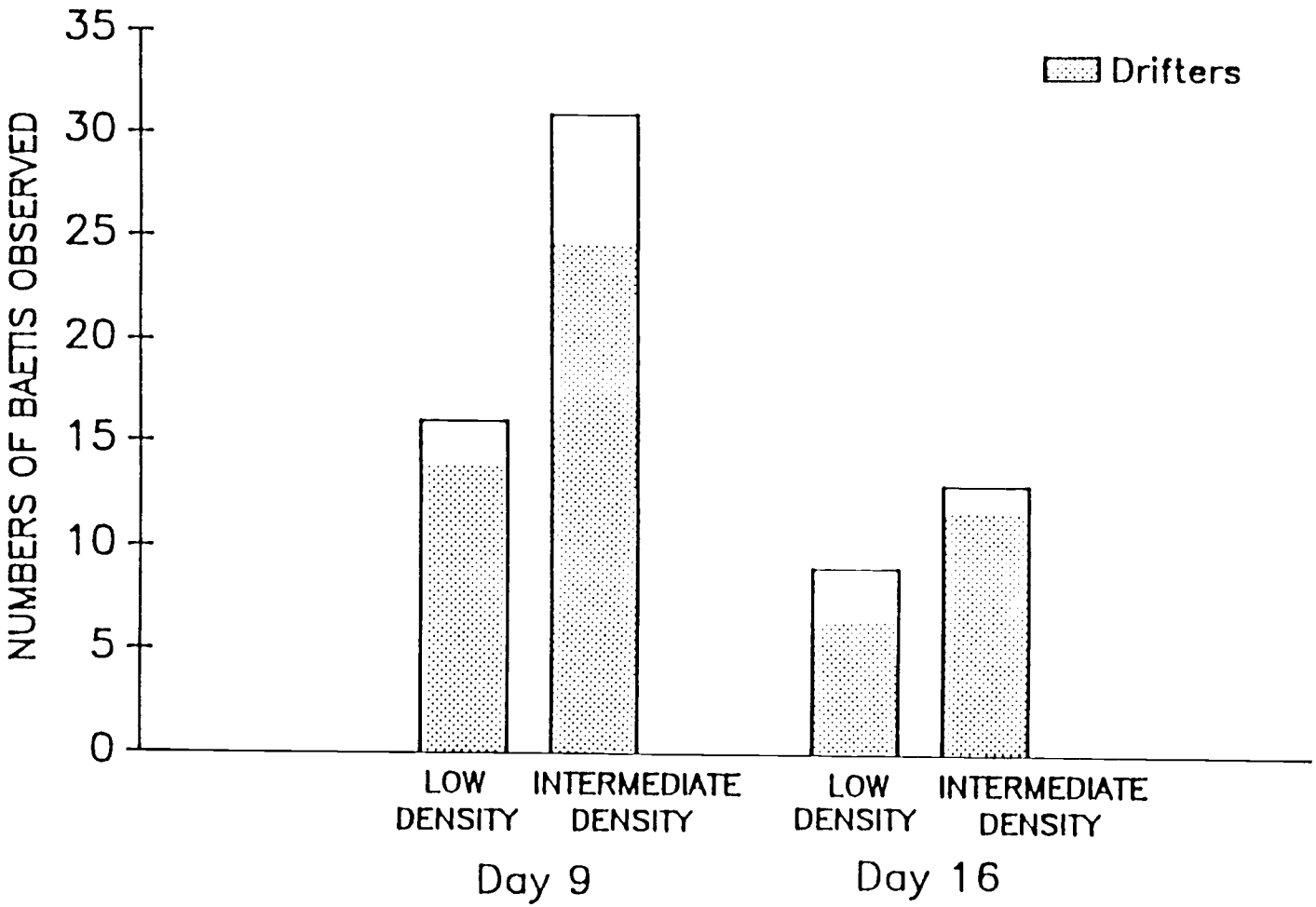

NUMBERS OF BAETIS OBSERVED
35
30
25
20
15
10
5
0
Drifters
LOW DENSITY
INTERMEDIATE DENSITY
LOW DENSITY
INTERMEDIATE DENSITY
Day 9
Day 16

Figure 3.12.

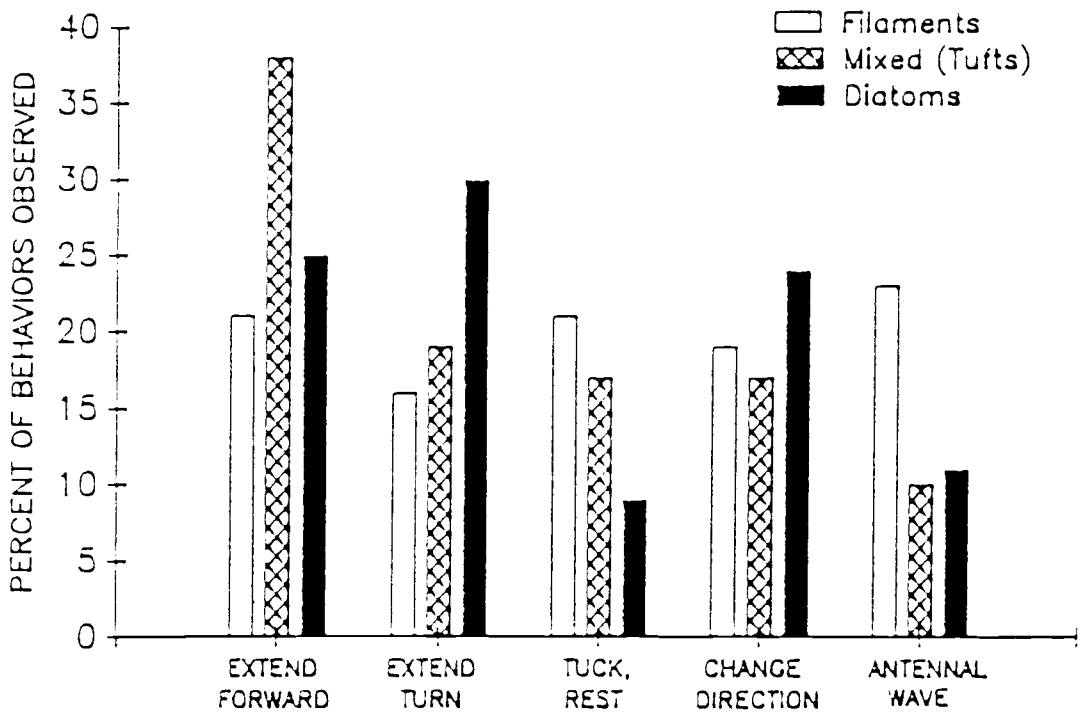


Figure 3.13 Comparison of movement behaviors exhibited by Juga foraging on filamentous, diatom, and mixed algal physiognomies.

Juga behavior after long-term exposure to different algal abundances

Both algal availability in streams where snails had been feeding for 30 d and algal physiogonomy where observations were made significantly affected rates of snail movement ($p < 0.05$, ANOVA). Juga introduced into the diatom-dominated assemblages travelled significantly faster and changed directions more often than in the less shaded streams dominated by filamentous algae. Snails in filamentous assemblages tended to extend towards the sides rather than in a forward direction.

Snails that previously had been feeding on diatoms moved significantly slower than snails from other treatments (Fig. 3.14) ($p < 0.001$, ANOVA). Juga from streams dominated by moderate levels of filamentous algae moved fastest, but only slightly faster than those from the denser filamentous assemblages. Directions of movement (angles changed or change in direction) were not affected by original feeding regime.

Discussion

My study examined the role of locomotion in foraging behavior under various conditions of algal availability. Locomotory behavior can serve several functions including food acquisition, predator avoidance, mate location and dispersal. Behaviors evolve in response to many physical and biological factors. For example, drifting behavior allows mayflies to escape from predators, but this movement also conveys the insect to new food resources. Other behaviors or morphologies may have arisen with less utility for the organism (Gould and Lewontin 1979). Regardless of their evolutionary origins, present-day behaviors have consequences that we can examine in terms of ecological performance.

Foraging variations among Dicosmoecus, Juga, and Baetis resulted in part from their contrasting functional morphologies. Both feeding and locomotory morphologies play a role in how grazers search for and consume algae. The snails, caddisfly and mayfly are representatives of three distinctly different functional groups, and mouthpart morphology constrains feeding efficiency on varying algal physiognomies. Juga, a rasper, does not appear able

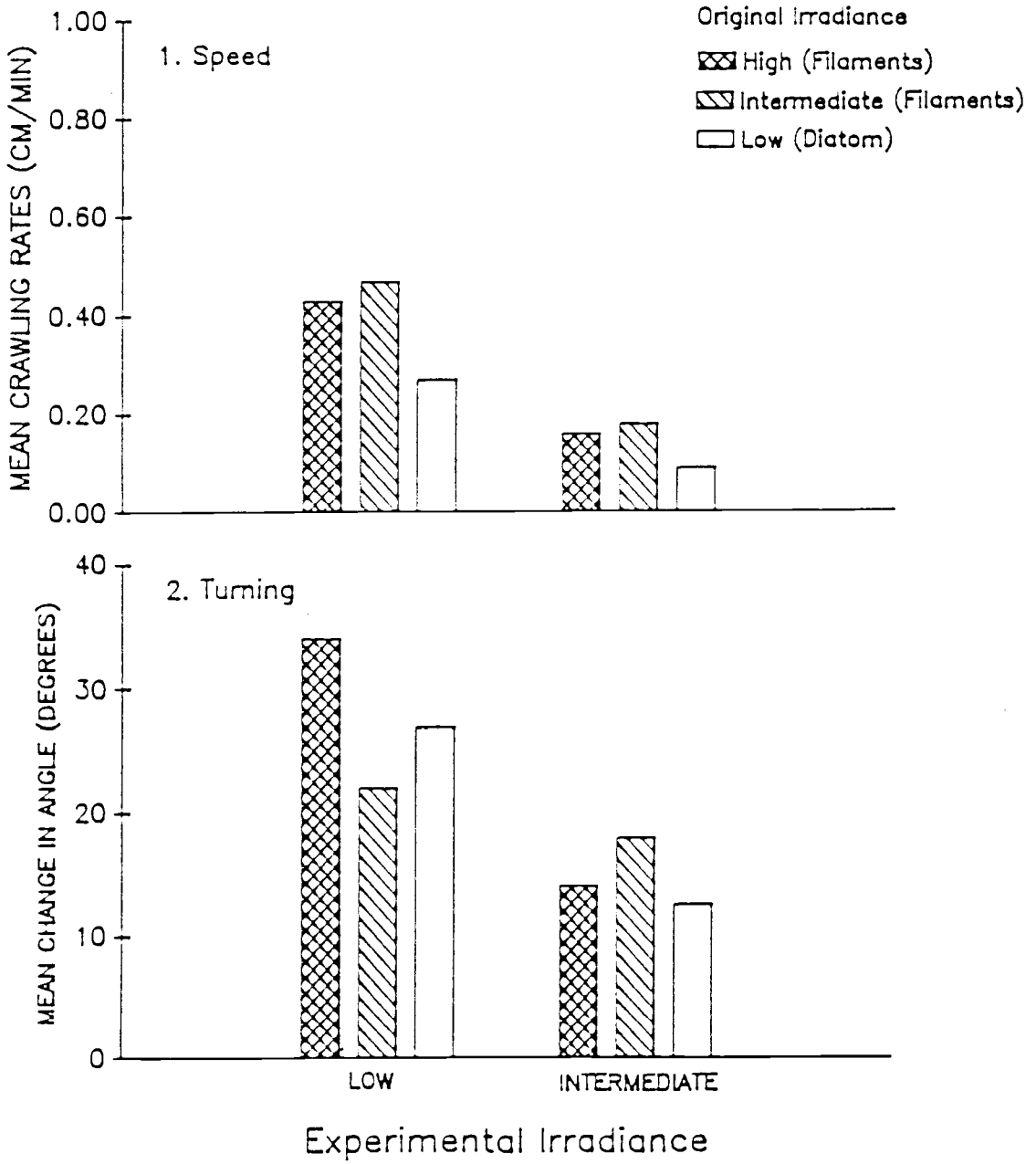


Figure 3.14 Comparison of Juga speed and turning movements in streams with low irradiance (diatom assemblage) and intermediate irradiance (filamentous algal assemblage) after 30 d exposure to either diatom assemblages (low irradiance) or filamentous assemblages (intermediate and high irradiances).

to consume filaments easily (Lamberti et al. 1987). Handling difficulties with filamentous assemblages led to decreased speed and changes in posture among snails during my study. The scraper Dicosmoecus efficiently consumes both diatom and filamentous algae assemblages by gathering algae with its forelegs, scraping with robust mandibles and brushing abundant setae on the labrum (Li and Gregory 1989). Baetis, a collector/gatherer, also can graze both diatoms and short filaments (Li, personal observation).

Mode of locomotion helps determine a grazer's ability to search for new resources and its capacity to adapt to changing resource availability. Juga depends on mucus secretion and a broad foot for locomotion and generally moves systematically over the substrate. Dicosmoecus is an active crawler capable of foraging over large areas. Patch-restricted movement of Baetis in abundant algae also has been demonstrated for other mayflies (Wiley and Kohler 1981), and this mayfly is well-known for its drifting capacity when moving long distances (Bohle 1978).

Contrasting responses to limited resources reflected not only morphological constraints but also dissimilar behavioral strategies. Juga foraging patterns remained similar throughout the study, though retracing became more common late in the experiment. Retracing behavior may have been similar to homing behavior of marine snails and chitons that locate feeding or resting sites by following self-made mucus trails or trails lain by conspecifics (Chelazzi et al. 1988, Deneubourg et al. 1988). When Juga were moved from depleted algal resources to new conditions, decreased speed appeared to be a response to hunger in contrast to postural changes associated with algal physiognomy. Dicosmoecus changed foraging strategy from linear movement early in the experiment to patch area foraging after prolonged algal depletion. Although caddisflies potentially could utilize a wide area, hunger constrained them to highly restricted patches. Snails might not cover as much area as caddisflies under resource-rich conditions, but they ranged over an area wider than foraging areas of caddisflies when algal abundance was limiting (Fig. 3.6).

Agile mayflies did not change strategies but increased the frequency of long-distance movement by drifting more readily when algae became scarce. Mayflies in other studies also persisted in abundant algae and drifted more readily at high animal densities (Bohle 1978, Elliott 1967).

These changes in foraging behavior may result in varying degrees of risk for grazers in natural streams. Some foragers become risk-prone when resources reach a minimal level (Caraco 1980; see Krebs and Stephens 1986 for review). Risks for stream herbivores include encountering greater dangers such as more predators, unfavorable physical conditions (Allan 1979, Peckarsky 1980), or searching for food resources in an unpredictable environment; patchy distribution of resources and microhabitat would further confound the potential risks (Townsend 1989, Pringle et al. 1988). The level of risk would vary with each grazer. For example, vulnerability to fish predation is greater to Baetis than Dicosmoecus, and snails are less tolerant of high velocities than Dicosmoecus (see Chapter 1).

Limitations created by life history requirements also may influence foraging strategies. Lifespan for Juga is several years, and these snails have greater latitude than univoltine organisms for using energy stores while searching for new food resources. Alternative foods may be encountered eventually . Thus, snails persist in systematic foraging even after prolonged algal depletion. In another study of food depletion and herbivore behavior, starved snails and limpets increased their movement to a maximum rate, then moved slowly in a random pattern similar to Juga (Calow 1974). Caddisflies, on the other hand, are restricted to a shorter interval during which they must reach pupation and emerge synchronously in order to reproduce. Valuable energy stores may be wasted searching for food in an area where resources have been scarce. Rather than searching for more abundant algae, hungry Dicosmoecus stayed in restricted areas. Dicosmoecus larvae gather abundant diatoms or filamentous algae with forelegs, mandibles and other head parts (Li and Gregory 1989), but a sparse assemblage of cells may have required more scraping

activity in concentrated areas. Hungry caddisflies risked the chance of encountering more abundant food patches for the certainty of scarce resources in a confined area. Mayflies drifted even when provided with abundant algae; mayflies crawl within small feeding patches, but long distance travel is accomplished by drifting. Multivoltine mayflies such as Baetis also have short lifespans, and must acquire enough energy for growth within a short time to emerge synchronously with other members of their cohort. When algae become less available, greater risks of vertebrate predation may be encountered by drifting behavior, but more abundant resources and temporary avoidance of invertebrate predators may be achieved by drifting.

Feeding habit also may influence behavioral strategies. Facultative herbivores, such as Juga, risk less when searching for new forage areas because they feed on allochthonous resources as well algae (Hawkins and Furnish 1987). More obligate herbivores, such as Dicosmoecus gilvipes, depend primarily on algal availability and must maximize consumption of even scarce supplies. Consumption of alternative resources such as decomposing leaves, which was reported by Lamberti and Resh (1979) but not observed in the present studies, would reduce risks related to energy loss, and might result in different foraging patterns.

Criteria for Baetis movement varies from that of other herbivores such as caddisflies and snails. Both invertebrate and vertebrate predators pose a constant threat in the stream environment (Allan 1985, Malmqvist and Sjostrom 1987, Peckarsky 1985). Mayflies may have developed a continually drifting strategy to escape predation, moving to new patches of food at the same time. The feeding morphology of Baetis indicates that this mayfly is a generalist that collects fine particles, algae, and microbes which would be abundant in a wide range of microhabitats. Probability of usable resources at a new location would be high because of its generalist feeding habit.

In this study, behavioral observations and experiments have shown that behavioral strategies could provide a mechanism for partitioning limited food

resources. Lotic herbivores can partition use of their algal resources through differences in feeding habit, foraging range, and speed. Behavioral observations revealed distinctive characteristics for each herbivore in this study, and these techniques would be useful for distinguishing fundamental differences among other organisms that share similar food resources. Foraging responses to algal physiognomies and hunger were constrained by intrinsic morphological and locomotory differences among stream herbivores. Behavioral observations quantified under conditions of varying resource availability revealed variations in foraging patterns and methods of harvest distinguishing a scraper caddisfly, rasper snail and collector/gatherer mayfly.

V. SUMMARY

Differences in foraging behavior among lotic herbivores exposed to varying resource conditions were revealed in this study by examining species-specific feeding movements, foraging patterns, and distributions. A mechanistic approach (sensu Price 1986) was used to quantify behaviors in the laboratory, then place behaviors in a larger context of distribution and foraging among stream populations. Temporal changes in behavior were observed by studying different instars in the laboratory, and by recording responses to changing habitat availability in a natural stream. Individuals enumerated on a microhabitat scale provided information about distribution on macrohabitat scales. The combination of behavioral observations and field distributions revealed intrinsic, consumer characteristics, and extrinsic resource and physical factors that determine lotic herbivore foraging strategies.

Varying morphologies and modes of locomotion can result in differing patterns of movement. When algae had not been depleted, the caddisfly Dicosmoecus gilvipes foraged primarily in linear patterns, whereas the mayfly Baetis tricaudatus foraged in small patches. The snail, Juga silicula also traversed linear paths, but responded to more abundant, dense algae by either more turning behavior or head waving. Hunger would be expected to affect feeding rate (Perry 1987, Schoener 1971), and observations of grazers during 31 days of low algal abundance revealed that hunger-related changes in foraging patterns are species-specific. Dicosmoecus were active and often wide-ranging foragers; however, fifth-instar larvae became sedentary after prolonged hunger in laboratory experiments, changing their foraging pattern to very small patches. Algae were consumed by scraping or brushing substrate surfaces, and restricted patch foraging appeared to be a behavioral adaptation for more concentrated scraping of scarce adnate algal cells. Though

filamentous algae were preferred, Dicosmoecus altered their foraging behavior to consume unicellular algae when necessary. Hungry Juga persisted in linear movement patterns longer than did Dicosmoecus; snails responded to newly introduced algal material by moving slowly while grazing.

Foraging is also influenced by a grazer's preference for available food resources. Efficiency on different algal physiogonomies may vary according to feeding morphology; for example, scraping caddisflies gathered filamentous algae easily, but rasping snails struggled to move through dense filaments, and moved more easily through diatoms or mixed assemblages. Distribution also may be affected by resource preferences. Whereas Dicosmoecus is a more obligate herbivore, snails have more general food habits (Hawkins & Furnish 1988). When algae is scarce snails might be more likely to switch resources and search in a greater variety of microhabitats than the more specialized caddisflies. At Big Elk Creek snails occupied almost all substrates and microhabitats, whereas third-, fourth-, and fifth-instar D. gilvipes preferred mid-channel bedrock and small boulders where algae were probably most available (Hawkins et al. 1982, Minshall 1984).

Developmental stages of caddisflies can influence movement rates, algal preferences and habitat selection. Responses to algal resources by instars of Dicosmoecus changed from diatoms to filamentous green algae during laboratory studies; mobility increased as larvae developed in the natural stream habitat. Co-occurring instars in the Big Elk simultaneously exploited stream margins and mid-stream habitats reflecting instar differences in behavior.

Mobility affords an adaptive response to a changing environment and increases an organism's scale of influence. Mobile organisms are likely to exhibit coarse-grained use of the environment, selecting macrohabitats rather

than microhabitats (Morris 1987, Townsend 1989). Mobility of crawling caddisflies and drifting mayflies facilitated use of broad macrohabitat patches; however, the habitat range explored by D. gilvipes is constrained by developmental stage, substrate preference and probably algal availability. Individual Juga silicula forage in smaller patches than D. gilvipes, but this snails' movement rates were similar to D. gilvipes during laboratory observations, and wide distribution in the Big Elk attested to its mobility during late spring. Snails such as J. silicula and Lithoglyphus virens are able to utilize a broad range of stream habitats.

Behavior serves as an interface between organisms and their environment; behavioral flexibility is crucial for adapting to an unpredictable environment (Hazlett 1988). Seasonal changes in behavior that occur among lotic herbivores are a means of maintaining behavioral flexibility and relevant to predictions of foraging behavior. Intrinsically constrained grazer characteristics (sensu Stephens and Krebs 198), particularly herbivore morphology, life history, mobility and hunger, as well as food resource characteristics, including algal physiognomy and availability, contribute to consumer foraging strategies. Benthic herbivores and their algal food resource also are constrained extrinsically by the physical environment of the stream, particularly by substrate availability, stream velocity and solar radiation, which are subject to abrupt temporal variation. In this study, variability in movement, feeding preferences, and habitat selection resulted in species-specific foraging strategies that provided flexible responses to temporal changes in resource availability and to the stream environment.

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APPENDICES

APPENDIX A. Physical Measurements of 0.25 m^2 quadrats at Big Elk Creek Study Area, March 20 - July 17, 1986. Abreviations are: Trsct = transect; Dist = distance from bank; Phi = phi scale for substrate size; Grvl = gravel; Bldr = Boulder.

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
320	1	0.5	10.0	0.12	9.0	0.00	0.00	0.00	0.25	0.00	0.00	0.75	0.00	0.00
320	1	1.0	25.0	0.07	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
320	1	1.5	48.0	0.04	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
320	1	2.0	50.0	0.04	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
320	1	2.5	50.0	0.33	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
320	1	3.0	50.0	0.56	11.0	0.00	0.00	0.00	0.25	0.00	0.00	0.25	0.00	0.50
320	1	3.5	52.0	0.48	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
320	1	4.0	45.0	0.64	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
320	1	4.5	48.0	0.05	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
320	1	5.0	30.0	-0.10	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
320	1	5.5	48.0	-0.07	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
320	1	6.0	38.0	0.05	6.5	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
320	1	6.5	24.0	0.02	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
320	1	7.0	45.0	0.45	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
320	1	7.5	32.0	-0.05	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
320	1	8.0	42.0	-0.10	10.0	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.50	0.00
320	1	8.5	42.0	-0.08	9.0	0.00	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00
320	1	9.0	38.0	0.01	9.0	0.00	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00
320	1	9.5	52.0	0.23	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
320	1	10.0	42.0	0.00	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
320	1	10.5	60.0	-0.02	9.0	0.00	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00
320	1	11.0	4.0	0.29	9.0	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00
320	1	11.5	72.0	-0.10	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.75
320	1	11.0	60.0	0.28	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
320	3	0.5	5.0	0.39	10.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00
320	3	1.0	0.0	0.31	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
320	3	1.5	30.0	-0.08	4.0	0.00	0.75	0.00	0.00	0.00	0.00	0.25	0.00	0.00
320	3	2.0	30.0	-0.18	4.0	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00	0.00
320	3	2.5	35.0	0.65	6.5	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
320	3	3.0	45.0	0.02	6.5	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
320	3	3.5	35.0	0.00	6.5	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
320	3	4.0	38.0	0.20	8.0	0.00	0.00	0.00	0.00	0.00	0.75	0.25	0.00	0.00
320	3	4.5	34.0	0.16	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
320	3	5.0	40.0	0.00	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
320	3	5.5	45.0	0.00	8.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
320	3	6.0	66.0	0.45	6.5	0.00	0.25	0.25	0.00	0.00	0.50	0.00	0.00	0.00
320	3	6.5	55.0	0.45	8.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
320	3	5.5	55.0	0.07	8.0	0.00	0.25	0.25	0.00	0.00	0.50	0.00	0.00	0.00
320	3	5.0	48.0	0.41	8.0	0.00	0.10	0.00	0.00	0.00	0.90	0.00	0.00	0.00
320	3	4.5	35.0	0.78	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
320	3	4.0	35.0	0.80	8.0	0.00	0.00	0.00	0.00	0.00	0.75	0.25	0.00	0.00
320	3	3.5	35.0	-0.14	9.0	0.00	0.00	0.00	0.00	0.00	0.25	0.75	0.00	0.00
320	3	3.0	25.0	0.37	8.0	0.10	0.00	0.25	0.00	0.00	0.65	0.00	0.00	0.00
320	3	2.5	28.0	0.07	8.0	0.25	0.00	0.10	0.00	0.00	0.65	0.00	0.00	0.00
320	3	2.0	25.0	-0.13	9.0	0.25	0.00	0.00	0.00	0.00	0.25	0.50	0.00	0.00
320	3	1.0	5.0	-0.01	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
320	3	0.5	5.0	0.01	3.0	0.60	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
320	3	0.0	7.0	0.02	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
320	3	1.0	30.0	0.02	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
320	3	1.5	10.0	0.31	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
320	3	2.0	30.0	0.28	9.0	0.00	0.00	0.00	0.00	0.00	0.25	0.75	0.00	0.00
320	3	2.5	32.0	0.15	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
320	3	3.0	45.0	0.69	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
320	4	0.5	24.0	-0.06	3.0	0.75	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
320	4	1.0	40.0	-0.07	8.0	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
320	4	1.5	45.0	0.18	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
320	4	3.0	30.0	0.03	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
320	4	2.5	38.0	1.06	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
320	4	1.5	30.0	0.31	9.0	0.00	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00
320	4	1.0	38.0	0.36	8.0	0.00	0.25	0.25	0.00	0.00	0.50	0.00	0.00	0.00
320	4	0.5	38.0	0.31	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
320	4	0.0	18.0	0.00	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
320	4	0.0	25.0	0.25	4.0	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00
320	4	0.5	30.0	0.42	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
320	4	1.0	15.0	0.18	4.0	0.25	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
320	4	1.5	12.0	0.42	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.50	0.00	0.00
320	4	2.0	20.0	0.08	4.0	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
320	5	2.5	38.0	0.75	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
320	5	2.0	35.0	0.45	11.0	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50
320	5	1.5	34.0	0.15	4.0	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
320	5	1.0	30.0	0.00	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
320	5	0.5	55.0	-0.07	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.50	0.00
320	5	0.0	55.0	0.00	4.0	0.25	0.50	0.00	0.00	0.00	0.00	0.25	0.00	0.00
410	1	2.0	30.0	0.01	8.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
410	1	2.5	43.0	0.19	8.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
410	1	4.3	5.0	0.03	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
410	1	9.5	50.0	0.62	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
410	1	8.5	53.0	0.42	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	1	8.0	39.0	0.60	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	1	7.5	32.0	0.58	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	1	7.0	38.0	0.48	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	1	6.5	28.0	0.53	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	1	6.0	20.0	0.74	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	1	5.5	16.0	0.42	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	1	5.0	14.0	0.24	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	1	4.5	4.0	-0.02	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	2	0.0	10.0	-0.03	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
410	2	0.5	28.0	0.06	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
410	2	1.0	26.0	0.02	3.0	0.75	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
410	2	1.5	24.0	-0.06	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
410	2	2.0	28.0	0.18	3.0	0.50	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00
410	2	2.5	29.0	0.21	4.0	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
410	2	3.0	25.0	-0.05	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
410	2	3.5	10.0	0.04	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
410	2	4.0	10.0	0.30	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
410	2	4.5	45.0	0.38	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
410	3	0.0	12.0	-0.02	3.0	0.60	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
410	3	0.5	10.0	0.00	5.0	0.00	0.00	0.75	0.00	0.00	0.25	0.00	0.00	0.00
410	3	1.0	17.0	-0.01	8.0	0.00	0.25	0.25	0.00	0.00	0.50	0.00	0.00	0.00
410	3	3.0	0.0	0.10	8.0	0.00	0.00	0.25	0.00	0.00	0.75	0.00	0.00	0.00
410	3	3.5	28.0	0.44	8.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
410	3	4.0	30.0	0.02	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
410	3	1.5	25.0	0.40	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	3	1.0	33.0	0.22	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	3	0.5	25.0	0.68	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	3	0.0	10.0	0.74	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	4	0.0	16.0	0.18	8.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
410	4	1.0	10.0	0.10	4.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
410	4	4.5	4.0	-0.04	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
410	4	5.0	10.0	0.00	9.0	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.00
410	4	5.5	16.0	-0.02	4.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
410	4	6.0	20.0	-0.02	8.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
410	4	6.5	10.0	0.06	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
410	4	7.0	30.0	0.04	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
410	4	6.5	25.0	0.15	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
410	4	1.0	35.0	0.14	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	4	0.5	24.0	0.10	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
410	4	0.0	8.0	0.00	3.0	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
422	1	0.5	15.0	0.01	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
422	1	1.0	23.0	0.30	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
422	1	1.5	29.0	0.15	8.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
422	1	2.0	32.0	0.35	8.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
422	1	2.5	29.0	0.35	8.0	0.25	0.25	0.00	0.00	0.00	0.50	0.00	0.00	0.00
422	1	3.0	35.0	0.21	8.0	0.15	0.15	0.00	0.00	0.00	0.70	0.00	0.00	0.00
422	1	3.5	33.0	0.40	11.0	0.00	0.25	0.00	0.00	0.00	0.25	0.00	0.00	0.50
422	1	4.0	40.0	0.04	11.0	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.50
422	1	4.5	43.0	0.03	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	1	5.0	35.0	0.30	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	1	5.5	44.0	0.08	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	1	6.0	35.0	0.19	11.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.75
422	1	6.5	40.0	0.08	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	1	7.0	36.0	0.13	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	1	7.5	25.0	0.08	8.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
422	1	8.0	40.0	0.04	4.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
422	1	8.5	40.0	0.06	4.0	0.00	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00
422	1	9.0	40.0	0.03	4.0	0.25	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
422	1	9.5	35.0	0.05	9.0	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.00	0.00
422	1	10.0	37.0	0.07	8.0	0.25	0.25	0.00	0.00	0.00	0.50	0.00	0.00	0.00
422	1	10.5	32.0	0.01	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.50
422	1	11.0	24.0	0.10	10.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.00
422	1	10.0	23.0	0.10	10.0	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00
422	1	9.5	41.0	0.03	4.0	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00
422	1	9.0	30.0	0.11	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
422	1	8.5	15.0	0.15	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
422	1	8.0	50.0	0.02	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
422	1	7.5	52.0	0.09	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	1	7.0	38.0	0.31	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
422	1	6.5	35.0	0.17	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	1	6.0	55.0	0.06	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
422	1	5.5	40.0	0.55	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	1	4.0	35.0	0.67	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	1	3.5	37.0	0.38	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	1	3.0	40.0	0.30	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	1	2.5	35.0	0.41	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	1	2.0	35.0	0.22	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
422	1	1.5	30.0	0.10	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
422	1	0.5	22.0	0.15	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
422	1	0.0	12.0	0.05	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
422	2	0.5	21.0	0.04	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
422	2	1.0	36.0	0.12	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
422	2	2.0	50.0	0.33	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
422	2	2.5	55.0	0.18	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	2	3.0	48.0	0.21	11.0	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.90
422	2	3.5	48.0	0.04	11.0	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50
422	2	4.0	50.0	0.05	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
422	2	4.5	40.0	0.11	4.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
422	2	5.0	28.0	0.02	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
422	2	5.5	8.0	0.59	8.0	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00
422	2	6.0	25.0	0.49	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
422	2	6.5	20.0	0.47	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.50	0.00
422	2	7.5	23.0	0.27	8.0	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.00	0.00
422	2	8.0	15.0	0.26	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
422	2	9.0	35.0	0.49	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
422	2	9.5	30.0	0.48	5.0	0.00	0.00	0.75	0.00	0.00	0.00	0.25	0.00	0.00
422	2	10.0	44.0	0.36	8.0	0.00	0.25	0.00	0.00	0.00	0.50	0.00	0.00	0.00
422	2	10.5	52.0	0.29	4.0	0.00	0.75	0.00	0.00	0.00	0.00	0.25	0.00	0.00
422	2	11.0	55.0	0.23	4.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
422	2	11.5	56.0	0.08	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
422	2	11.5	30.0	0.01	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
422	2	11.0	25.0	0.07	4.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
422	2	10.5	32.0	0.12	4.0	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
422	2	10.0	37.0	0.07	3.0	0.75	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
422	2	9.5	35.0	0.16	3.0	0.60	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00
422	2	9.0	44.0	0.09	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00
422	2	8.5	52.0	0.04	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
422	2	8.0	60.0	0.06	9.0	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
422	2	7.5	55.0	0.15	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
422	2	7.0	58.0	0.05	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
422	2	6.5	78.0	0.01	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
422	2	6.0	78.0	0.05	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	2	5.5	88.0	0.12	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	2	3.0	84.0	0.12	11.0	0.45	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.45

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
422	2	2.5	80.0	0.05	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
422	2	2.0	73.0	0.13	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
422	2	1.5	71.0	0.07	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
422	2	1.0	32.0	0.05	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
422	2	0.5	20.0	0.00	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
422	2	0.0	10.0	0.00	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
514	1	0.5	11.0	0.11	3.0	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00
514	1	1.0	25.0	0.19	4.0	0.00	0.75	0.00	0.00	0.00	0.25	0.00	0.00	0.00
514	1	1.5	30.0	0.23	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
514	1	2.0	30.0	0.36	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
514	1	2.5	30.0	0.01	4.0	0.00	0.90	0.00	0.00	0.10	0.00	0.00	0.00	0.00
514	1	3.0	32.0	0.21	8.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
514	1	3.5	32.0	0.30	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
514	1	4.0	35.0	0.08	11.0	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50
514	1	4.5	34.0	0.21	11.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.75
514	1	5.0	38.0	0.06	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
514	1	5.5	38.0	0.10	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.50
514	1	6.0	47.0	0.18	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
514	1	6.5	40.0	0.09	11.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.75
514	1	7.0	8.0	0.28	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	1	7.5	38.0	0.06	3.0	0.35	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.35
514	1	8.0	19.0	0.13	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
514	1	8.5	36.0	0.07	4.0	0.00	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.25
514	1	9.0	30.0	0.06	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
514	1	9.5	32.0	0.05	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
514	1	10.0	38.0	0.00	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
514	1	10.5	34.0	0.09	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
514	1	11.0	41.0	0.08	3.0	0.50	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.25
514	1	8.5	38.0	0.01	3.0	0.50	0.25	0.00	0.00	0.00	0.25	0.00	0.00	0.00
514	1	8.0	38.0	0.02	3.0	0.50	0.00	0.00	0.00	0.20	0.20	0.00	0.00	0.10
514	1	7.5	45.0	0.08	3.0	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00
514	1	6.0	60.0	0.02	11.0	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.65
514	1	5.5	43.0	0.47	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
514	1	5.0	50.0	0.37	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
514	1	4.5	32.0	0.10	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
514	1	4.0	27.0	0.19	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
514	1	3.5	41.0	0.58	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	1	3.0	44.0	0.35	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	1	3.5	34.0	-0.10	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	1	2.0	36.0	-0.14	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	1	2.5	35.0	0.31	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	1	1.0	44.0	0.21	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	1	1.5	36.0	0.31	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	1	0.5	34.0	0.30	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	1	0.0	32.0	0.01	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
514	2	0.5	22.0	0.01	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
514	2	1.0	35.0	0.10	3.0	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
514	2	1.5	40.0	0.01	4.0	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
514	2	2.0	45.0	0.04	4.0	0.00	0.50	0.00	0.00	0.00	0.25	0.00	0.00	0.00
514	2	2.5	51.0	0.08	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
514	2	3.0	55.0	-0.16	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.50
514	2	3.5	52.0	-0.05	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	2	4.0	52.0	-0.04	11.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.75
514	2	4.5	52.0	0.07	11.0	0.25	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.50
514	2	5.0	48.0	0.20	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
514	2	5.5	46.0	0.09	11.0	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50
514	2	6.0	42.0	0.40	4.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	2	6.5	38.0	0.12	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.90
514	2	7.0	44.0	0.38	5.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
514	2	7.5	43.0	0.05	11.0	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.75
514	2	8.0	35.0	0.02	4.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	2	8.5	34.0	-0.08	4.0	0.00	0.90	0.00	0.00	0.00	0.00	0.10	0.00	0.00
514	2	9.0	10.0	0.45	10.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
514	2	9.5	40.0	-0.10	5.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
514	2	10.0	43.0	0.07	5.0	0.00	0.50	0.25	0.00	0.00	0.00	0.50	0.00	0.00
514	2	10.5	40.0	-0.02	9.0	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	2	11.0	38.0	0.08	3.0	0.35	0.00	0.35	0.00	0.00	0.30	0.00	0.00	0.00
514	2	11.0	34.0	-0.03	8.0	0.25	0.25	0.00	0.00	0.00	0.50	0.00	0.00	0.00
514	2	9.0	24.0	0.06	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
514	2	8.5	20.0	0.12	4.0	0.35	0.35	0.00	0.00	0.00	0.30	0.00	0.00	0.00
514	2	8.0	46.0	0.24	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
514	2	7.5	46.0	0.16	3.0	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
514	2	7.0	55.0	0.14	9.0	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00
514	2	6.5	50.0	0.11	9.0	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00
514	2	6.0	55.0	-0.06	9.0	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00
514	2	5.5	65.0	0.02	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	2	5.0	43.0	0.07	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
514	2	4.5	61.0	0.00	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	2	4.0	44.0	0.06	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
514	2	3.5	74.0	-0.05	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
514	2	3.0	76.0	-0.03	3.0	0.50	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.50
514	2	2.5	65.0	0.00	11.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.50
514	2	2.0	68.0	-0.07	4.0	0.00	0.75	0.00	0.00	0.00	0.25	0.00	0.00	0.00
514	2	1.5	66.0	0.34	10.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.50	0.25
514	2	1.0	68.0	0.18	4.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
514	2	0.5	49.0	0.29	10.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.50	0.00
514	2	0.0	10.0	0.09	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
514	3	0.5	28.0	0.24	9.0	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.50
514	3	1.0	50.0	0.06	9.0	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	3	1.5	50.0	0.03	4.0	0.00	0.40	0.00	0.00	0.00	0.40	0.00	0.00	0.00
514	3	2.0	22.0	0.32	13.0	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	3	2.5	56.0	0.10	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	3	3.0	50.0	0.15	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	3	3.5	52.0	0.18	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
514	3	4.0	49.0	0.17	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	3	4.5	43.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
514	3	5.0	50.0	-0.03	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
514	3	5.5	48.0	0.30	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	3	6.0	50.0	0.12	11.0	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.75
514	3	6.5	48.0	0.25	4.0	0.00	0.75	0.00	0.25	0.00	0.00	0.00	0.00	0.00
514	3	7.5	39.0	0.03	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
514	3	8.0	35.0	0.34	8.0	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00
514	3	8.5	38.0	0.40	4.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	3	9.0	38.0	0.08	9.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	3	9.5	32.0	-0.12	4.0	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00
514	3	10.0	36.0	0.35	5.0	0.00	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00
514	3	10.5	38.0	0.17	8.0	0.00	0.00	0.25	0.00	0.00	0.75	0.00	0.00	0.00
514	3	11.0	42.0	0.12	5.0	0.00	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00
514	3	11.5	55.0	-0.07	7.0	0.00	0.00	0.00	0.00	0.90	0.00	0.00	0.10	0.00
514	3	13.0	48.0	0.08	3.0	0.34	0.33	0.33	0.00	0.00	0.00	0.00	0.00	0.00
514	3	13.5	48.0	0.01	3.0	0.40	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.10
514	3	12.5	51.0	0.03	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	3	12.0	8.0	0.00	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
514	3	11.5	53.0	0.03	9.0	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00
514	3	11.0	28.0	0.15	9.0	0.30	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.35
514	3	10.5	51.0	0.00	4.0	0.00	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.25
514	3	10.0	50.0	0.13	9.0	0.00	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00
514	3	9.5	56.0	0.17	10.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.50	0.00
514	3	9.0	79.0	-0.05	10.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00
514	3	8.5	74.0	-0.05	10.0	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00
514	3	8.0	43.0	0.27	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
514	3	8.5	64.0	0.24	10.0	0.00	0.10	0.00	0.00	0.00	0.40	0.00	0.40	0.00
514	3	7.0	45.0	0.35	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
514	3	6.5	60.0	0.11	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	3	6.0	60.0	0.04	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
514	3	5.5	58.0	-0.10	9.0	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	3	5.0	52.0	0.00	13.0	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	3	4.5	20.0	0.51	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
514	3	3.5	23.0	0.65	9.0	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	3	3.0	35.0	-0.09	9.0	0.25	0.25	0.00	0.00	0.00	0.00	0.25	0.00	0.00
514	3	2.5	29.0	-0.05	9.0	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	3	2.0	36.0	0.15	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	3	1.5	43.0	0.00	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
514	3	1.0	50.0	0.02	3.0	0.50	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00
514	3	0.5	51.0	0.22	4.0	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00
514	3	0.0	46.0	0.35	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
514	4	0.5	12.0	0.03	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
514	4	1.0	28.0	0.09	9.0	0.00	0.00	0.00	0.00	0.50	0.00	0.50	0.00	0.00
514	4	1.5	33.0	0.35	11.0	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.50
514	4	2.0	31.0	0.24	5.0	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00
514	4	2.5	22.0	0.12	9.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	4	3.0	30.0	0.17	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
514	4	3.5	33.0	0.02	9.0	0.00	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00
514	4	4.0	30.0	-0.15	4.0	0.00	0.75	0.00	0.00	0.00	0.25	0.00	0.00	0.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
514	4	4.5	32.0	-0.18	4.0	0.00	0.50	0.00	0.25	0.00	0.25	0.00	0.00	0.00
514	4	5.0	30.0	0.10	8.0	0.00	0.00	0.00	0.50	0.00	0.50	0.00	0.00	0.00
514	4	5.5	36.0	0.10	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
514	4	6.0	34.0	0.24	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
514	4	5.5	33.0	0.18	9.0	0.00	0.30	0.00	0.00	0.00	0.35	0.35	0.00	0.00
514	4	5.0	2.0	0.19	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
514	4	4.5	9.0	0.73	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
514	4	4.0	33.0	-0.12	10.0	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.90	0.00
514	4	3.5	26.0	0.45	8.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
514	4	3.0	25.0	0.11	8.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
514	4	2.5	29.0	0.35	8.0	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00
514	4	1.0	24.0	0.12	8.0	0.00	0.25	0.25	0.00	0.00	0.50	0.00	0.00	0.00
514	4	0.5	22.0	0.09	5.0	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00
514	4	0.0	18.0	0.25	5.0	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.00	0.00
514	4	0.0	9.0	0.07	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
514	4	0.5	3.0	-0.03	9.0	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00
514	4	1.0	22.0	0.00	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
514	4	2.0	13.0	0.16	9.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	4	2.5	24.0	0.62	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
514	4	3.0	24.0	0.28	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
514	4	3.5	27.0	-0.02	9.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
514	4	4.0	24.0	0.69	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
514	4	4.5	46.0	0.12	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.50
514	4	5.0	48.0	0.05	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.50
514	4	5.5	42.0	0.59	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	4	6.0	38.0	0.40	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	4	5.5	34.0	0.05	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	4	5.0	33.0	0.09	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	4	4.5	32.0	0.39	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	4	4.0	26.0	-0.03	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	4	3.5	26.0	0.27	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	4	3.0	28.0	0.47	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	4	2.5	27.0	0.57	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	4	2.0	27.0	0.85	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	4	1.5	29.0	0.52	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	4	1.0	18.0	0.52	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	4	0.5	24.0	0.21	11.0	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.75
514	4	0.0	8.0	-0.15	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	5	0.5	15.0	0.23	7.0	0.10	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.00
514	5	1.0	22.0	0.38	7.0	0.00	0.00	0.00	0.00	0.75	0.00	0.25	0.00	0.00
514	5	2.0	21.0	0.05	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
514	5	2.5	30.0	0.17	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
514	5	3.0	38.0	0.40	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.75
514	5	3.5	32.0	0.38	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	5	4.0	35.0	-0.20	9.0	0.00	0.25	0.25	0.00	0.00	0.00	0.50	0.00	0.00
514	5	4.5	38.0	0.16	5.0	0.00	0.00	0.75	0.00	0.00	0.25	0.00	0.00	0.00
514	5	4.0	38.0	0.20	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
514	5	4.0	42.0	0.24	7.0	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
514	5	3.5	35.0	0.22	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
514	5	3.0	43.0	-0.06	4.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
514	5	2.5	45.0	0.02	5.0	0.00	0.00	0.50	0.00	0.50	0.00	0.00	0.00	0.00
514	5	2.0	48.0	0.20	5.0	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00
514	5	1.5	28.0	0.10	5.0	0.50	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00
514	5	1.0	30.0	0.13	3.0	0.50	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00
514	5	0.5	16.0	0.01	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
514	5	0.0	5.0	0.00	5.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
514	5	0.0	30.0	-0.02	5.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	5	0.5	42.0	0.12	9.0	0.00	0.10	0.00	0.00	0.00	0.00	0.90	0.00	0.00
514	5	1.0	48.0	0.22	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	5	1.5	45.0	0.03	10.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.50	0.00
514	5	2.0	38.0	-0.07	4.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
514	5	2.5	45.0	-0.17	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
514	5	3.0	51.0	-0.20	10.0	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.90	0.00
514	5	3.5	34.0	0.17	9.0	0.00	0.00	0.00	0.25	0.00	0.00	0.75	0.00	0.00
514	5	4.0	45.0	0.45	9.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
514	5	4.5	42.0	0.21	8.0	0.00	0.00	0.00	0.50	0.00	0.50	0.00	0.00	0.00
514	5	4.0	40.0	-0.10	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	5	3.5	46.0	0.05	9.0	0.00	0.00	0.00	0.00	0.00	0.25	0.75	0.00	0.00
514	5	3.0	54.0	0.06	9.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
514	5	2.5	42.0	0.17	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
514	5	2.0	43.0	0.25	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
514	5	1.5	43.0	0.08	11.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.50
514	5	1.0	29.0	0.05	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
514	5	0.5	25.0	0.08	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
514	5	0.0	8.0	0.11	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	1	0.5	6.0	0.01	8.0	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
528	1	1.0	23.0	0.07	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
528	1	1.5	26.0	0.03	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
528	1	2.0	30.0	0.06	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
528	1	2.5	35.0	0.11	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	1	3.0	34.0	0.18	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	1	3.5	33.0	0.04	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	1	4.0	30.0	0.11	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
528	1	4.5	37.0	0.17	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
528	1	5.0	35.0	0.10	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
528	1	5.5	34.0	0.03	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
528	1	6.0	33.0	0.08	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
528	1	6.5	29.0	0.20	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
528	1	7.0	29.0	0.02	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
528	1	7.5	45.0	-0.05	3.0	0.50	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.40
528	1	8.0	20.0	0.14	4.0	0.25	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.25
528	1	7.5	31.0	0.01	8.0	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00
528	1	7.0	27.0	0.28	8.0	0.00	0.00	0.25	0.00	0.25	0.50	0.00	0.00	0.00
528	1	6.5	32.0	-0.05	8.0	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00	0.00
528	1	6.0	33.0	0.01	3.0	0.50	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00
528	1	5.5	40.0	0.04	3.0	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
528	1	5.0	51.0	0.00	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
528	1	4.5	44.0	0.11	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
528	1	4.0	30.0	0.40	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	1	3.5	28.0	0.38	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
528	1	3.0	32.0	0.40	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
528	1	2.5	34.0	0.34	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
528	1	2.0	35.0	0.34	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	1	1.5	28.0	0.44	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
528	1	1.0	28.0	0.35	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
528	1	0.5	15.0	0.20	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
528	1	0.0	12.0	-0.04	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
528	2	0.5	43.0	0.11	4.0	0.00	0.75	0.00	0.00	0.00	0.25	0.00	0.00	0.00
528	2	1.0	33.0	0.01	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
528	2	1.5	34.0	0.14	4.0	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00	0.00
528	2	2.0	23.0	0.12	8.0	0.25	0.25	0.00	0.00	0.00	0.50	0.00	0.00	0.00
528	2	2.5	18.0	0.14	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
528	2	3.0	23.0	0.08	6.5	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00
528	2	5.0	0.0	0.00	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
528	2	5.5	18.0	0.04	4.0	0.35	0.35	0.00	0.00	0.00	0.30	0.00	0.00	0.00
528	2	6.0	18.0	-0.04	8.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
528	2	6.5	20.0	0.25	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
528	2	7.0	16.0	0.03	8.0	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
528	2	7.5	18.0	0.00	8.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
528	2	8.0	11.0	0.48	9.0	0.00	0.25	0.00	0.00	0.00	0.25	0.50	0.00	0.00
528	2	8.5	27.0	0.03	8.0	0.00	0.25	0.25	0.00	0.00	0.50	0.00	0.00	0.00
528	2	9.0	18.0	0.08	5.0	0.00	0.35	0.35	0.00	0.00	0.30	0.00	0.00	0.00
528	2	9.5	14.0	0.26	9.0	0.10	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.00
528	2	10.0	35.0	0.15	3.0	0.35	0.35	0.00	0.00	0.00	0.25	0.00	0.00	0.00
528	2	10.5	28.0	0.07	3.0	0.50	0.00	0.25	0.00	0.00	0.00	0.15	0.00	0.00
528	2	10.5	10.0	0.09	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
528	2	10.0	30.0	0.00	3.0	0.90	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00
528	2	9.5	20.0	0.00	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00
528	2	8.0	34.0	0.04	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.50
528	2	7.5	52.0	0.02	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
528	2	7.0	35.0	0.08	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
528	2	6.5	64.0	0.06	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
528	2	6.0	30.0	0.12	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	2	5.5	40.0	-0.07	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
528	2	5.0	34.0	0.09	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	2	4.5	29.0	0.23	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	2	4.0	34.0	0.31	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	2	3.5	24.0	0.40	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	2	3.0	23.0	0.36	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	2	2.0	24.0	0.35	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
528	2	1.5	23.0	0.32	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
528	2	1.0	23.0	0.28	11.0	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85
528	2	0.5	26.0	0.05	11.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.50
528	2	0.0	5.0	0.04	3.0	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
528	3	0.5	21.0	0.38	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
528	3	1.0	32.0	0.05	11.0	0.00	0.10	0.00	0.00	0.00	0.00	0.40	0.00	0.50
528	3	1.5	3.0	0.28	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
528	3	2.0	6.0	0.41	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
528	3	4.5	23.0	-0.03	8.0	0.00	0.00	0.00	0.00	0.25	0.75	0.00	0.00	0.00
528	3	4.5	27.0	0.34	8.0	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00
528	3	4.0	23.0	0.08	4.0	0.00	0.50	0.00	0.00	0.25	0.25	0.00	0.00	0.00
528	3	3.5	34.0	0.40	4.0	0.00	0.50	0.00	0.00	0.25	0.25	0.00	0.00	0.00
528	3	3.0	34.0	0.05	4.0	0.00	0.50	0.00	0.00	0.00	0.25	0.00	0.00	0.25
528	3	2.5	13.0	0.46	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
528	3	2.0	16.0	0.20	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
528	3	0.5	15.0	-0.06	8.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
528	3	0.0	14.0	-0.02	4.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
528	3	0.0	6.0	0.00	9.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
528	3	0.5	8.0	0.11	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
528	3	1.5	18.0	0.17	9.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
528	3	2.5	15.0	0.14	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
528	3	3.0	15.0	0.02	8.0	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
528	3	3.5	32.0	-0.20	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
528	3	4.0	3.0	0.48	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
528	3	4.5	2.0	0.28	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
528	3	5.0	18.0	0.47	5.0	0.00	0.00	0.75	0.00	0.00	0.00	0.25	0.00	0.00
528	3	5.5	14.0	0.30	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
528	3	6.0	13.0	0.40	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	3	5.5	14.0	0.18	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
528	3	5.0	31.0	0.22	4.0	0.00	0.50	0.00	0.00	0.00	0.25	0.00	0.00	0.25
528	3	4.5	32.0	0.09	9.0	0.00	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00
528	3	4.0	44.0	0.04	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
528	3	3.0	32.0	0.08	5.0	0.25	0.00	0.65	0.00	0.00	0.00	0.10	0.00	0.00
528	3	2.5	39.0	0.22	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
528	3	2.0	42.0	0.10	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	3	1.5	34.0	0.08	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
528	3	1.0	25.0	-0.14	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
528	3	0.5	12.0	-0.03	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
528	4	0.5	18.0	0.00	13.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
528	4	1.0	24.0	0.02	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
528	4	1.5	40.0	0.23	11.0	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.50
528	4	2.0	31.0	0.01	4.0	0.00	0.35	0.35	0.00	0.00	0.00	0.30	0.00	0.00
528	4	2.5	30.0	-0.03	9.0	0.15	0.10	0.00	0.00	0.00	0.00	0.75	0.00	0.00
528	4	3.0	40.0	0.15	5.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
528	4	3.5	40.0	-0.05	4.0	0.00	0.50	0.00	0.00	0.25	0.00	0.25	0.00	0.00
528	4	4.0	35.0	0.03	9.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
528	4	4.5	32.0	0.28	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.50
528	4	5.0	28.0	0.04	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
528	4	5.5	33.0	0.06	11.0	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.50
528	4	5.0	26.0	0.00	11.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.75
528	4	4.5	23.0	0.07	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	4	4.0	34.0	-0.10	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.50

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
528	4	3.5	26.0	-0.11	8.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
528	4	3.0	16.0	-0.09	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	4	2.5	23.0	-0.08	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
528	4	2.0	23.0	0.50	8.0	0.00	0.00	0.00	0.50	0.00	0.50	0.00	0.00	0.00
528	4	0.0	21.0	0.24	4.0	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00	0.00
528	4	0.0	13.0	0.31	4.0	0.00	0.50	0.25	0.00	0.00	0.25	0.00	0.00	0.00
528	4	1.0	10.0	0.15	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
528	4	1.5	7.0	0.18	9.0	0.33	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00
528	4	2.0	5.0	0.05	11.0	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.45
528	4	3.0	11.0	0.01	9.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
528	4	4.0	17.0	0.15	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
528	4	5.0	14.0	0.13	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
528	4	4.5	20.0	0.72	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	4	4.0	12.0	1.30	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	4	3.5	13.0	1.05	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	4	3.0	19.0	1.47	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	4	2.5	32.0	0.13	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	4	2.0	16.0	0.30	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	4	1.5	11.0	0.50	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	4	1.0	8.0	0.06	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	4	0.5	6.0	0.12	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	4	0.0	2.0	0.02	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	5	0.5	8.0	0.01	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
528	5	1.5	24.0	0.06	8.0	0.25	0.25	0.00	0.00	0.00	0.50	0.00	0.00	0.00
528	5	2.0	26.0	0.40	11.0	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.50
528	5	2.5	32.0	-0.10	11.0	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50
528	5	3.0	25.0	0.21	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
528	5	3.5	30.0	0.10	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
528	5	4.0	20.0	0.06	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
528	5	4.5	20.0	0.04	8.0	0.00	0.00	0.00	0.50	0.00	0.50	0.00	0.00	0.00
528	5	5.0	13.0	0.28	8.0	0.00	0.00	0.25	0.00	0.00	0.75	0.00	0.00	0.00
528	5	5.5	10.0	0.00	10.0	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.90	0.00
528	5	6.0	10.0	0.05	5.0	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50
528	5	6.0	5.0	0.21	6.0	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00
528	5	4.0	30.0	0.02	5.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
528	5	3.5	20.0	0.14	4.0	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00	0.00
528	5	3.0	10.0	0.22	4.0	0.00	0.50	0.00	0.50	0.00	0.00	0.00	0.00	0.00
528	5	2.5	18.0	0.33	4.0	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00	0.00
528	5	2.0	18.0	0.29	4.0	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
528	5	1.5	19.0	0.36	4.0	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00
528	5	1.0	16.0	0.35	5.0	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00
528	5	0.5	13.0	0.40	4.0	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
528	5	0.0	4.0	0.02	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
528	5	0.5	10.0	-0.04	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
528	5	1.0	22.0	-0.03	9.0	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.00	0.00
528	5	1.5	38.0	0.07	11.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.50
528	5	2.0	41.0	-0.06	3.0	0.35	0.35	0.00	0.00	0.00	0.35	0.00	0.00	0.00
528	5	2.5	35.0	-0.06	3.0	0.50	0.25	0.00	0.00	0.00	0.00	0.25	0.00	0.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
528	5	3.0	40.0	0.20	10.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00
528	5	3.5	26.0	0.25	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	5	4.0	41.0	0.42	4.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
528	5	4.5	39.0	0.18	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
528	5	4.5	31.0	0.00	4.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
528	5	4.0	10.0	-0.01	10.0	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.90	0.00
528	5	3.5	5.0	0.45	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
528	5	3.0	10.0	0.21	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
528	5	2.5	22.0	0.17	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
528	5	2.0	34.0	0.04	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
528	5	1.0	32.0	0.05	11.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.50
528	5	0.5	25.0	0.08	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
528	5	0.0	5.0	0.15	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	1	0.5	12.0	0.21	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
616	1	1.0	20.0	0.19	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.50
616	1	1.5	21.0	0.02	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
616	1	2.0	32.0	-0.02	4.0	0.00	0.75	0.00	0.00	0.00	0.25	0.00	0.00	0.00
616	1	2.5	29.0	0.08	8.0	0.00	0.00	0.00	0.00	0.00	0.75	0.25	0.00	0.00
616	1	3.0	30.0	0.33	8.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	1	3.5	26.0	0.02	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
616	1	4.0	24.0	0.06	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
616	1	5.5	13.0	0.06	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	1	7.5	6.0	0.00	4.0	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
616	1	7.0	12.0	0.07	4.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
616	1	6.5	29.0	0.12	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
616	1	6.0	15.0	0.01	3.0	0.75	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00
616	1	4.5	30.0	0.31	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	1	4.0	29.0	0.33	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	1	3.5	27.0	0.27	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	1	3.0	34.0	0.20	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	1	2.5	29.0	0.30	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	1	1.5	43.0	-0.07	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	1	1.0	28.0	0.11	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	1	0.5	20.0	0.15	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	1	0.0	11.0	0.13	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
616	2	0.5	13.0	0.00	3.0	0.75	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00
616	2	1.0	15.0	0.01	3.0	0.75	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00
616	2	1.5	17.0	0.02	3.0	0.50	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00
616	2	2.0	22.0	0.04	3.0	0.75	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00
616	2	2.5	26.0	0.00	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
616	2	3.0	17.0	0.00	8.0	0.00	0.25	0.00	0.00	0.00	0.50	0.00	0.00	0.00
616	2	3.5	21.0	0.25	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
616	2	4.0	5.0	0.21	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
616	2	4.5	24.0	0.11	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
616	2	5.0	21.0	0.20	9.0	0.10	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.00
616	2	5.5	28.0	-0.04	9.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	2	6.0	23.0	-0.01	9.0	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00
616	2	5.5	23.0	0.02	9.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
616	2	5.0	29.0	0.11	5.0	0.00	0.00	0.90	0.00	0.00	0.00	0.10	0.00	0.00
616	2	4.5	28.0	0.15	5.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
616	2	4.0	22.0	-0.02	8.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
616	2	3.5	20.0	0.24	5.0	0.00	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00
616	2	3.0	25.0	0.20	5.0	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00
616	2	2.5	27.0	0.21	11.0	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.90
616	2	2.0	31.0	0.24	6.0	0.00	0.50	0.00	0.50	0.00	0.00	0.00	0.00	0.00
616	2	1.5	25.0	0.18	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
616	2	1.0	26.0	0.06	5.0	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
616	2	0.5	22.0	0.01	4.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
616	2	0.0	26.0	0.11	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
616	2	0.0	26.0	0.04	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	2	0.5	37.0	0.08	3.0	0.35	0.35	0.00	0.00	0.00	0.00	0.30	0.00	0.00
616	2	1.0	48.0	0.02	9.0	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	2	1.5	45.0	0.04	3.0	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00
616	2	2.0	40.0	0.15	10.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.00
616	2	2.5	55.0	0.00	10.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.50	0.00
616	2	3.0	30.0	0.07	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	2	3.0	52.0	-0.02	3.0	0.50	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00
616	2	2.5	50.0	0.01	9.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	2	2.0	57.0	0.00	9.0	0.00	0.40	0.00	0.00	0.00	0.00	0.45	0.00	0.00
616	2	1.5	40.0	-0.02	10.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00
616	2	1.0	49.0	0.05	4.0	0.00	0.75	0.00	0.00	0.00	0.25	0.00	0.00	0.00
616	2	0.5	50.0	0.04	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
616	2	0.0	47.0	0.09	9.0	0.00	0.25	0.25	0.00	0.00	0.00	0.50	0.00	0.00
616	3	0.5	13.0	0.25	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
616	3	1.0	15.0	0.27	8.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
616	3	1.5	12.0	0.03	8.0	0.00	0.10	0.00	0.00	0.00	0.90	0.00	0.00	0.00
616	3	2.0	13.0	0.12	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
616	3	2.5	25.0	-0.09	8.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
616	3	3.0	30.0	0.14	11.0	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.75
616	3	3.5	23.0	0.17	9.0	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	3	4.0	26.0	0.15	11.0	0.00	0.15	0.00	0.00	0.00	0.10	0.00	0.00	0.75
616	3	4.5	22.0	0.14	11.0	0.00	0.15	0.00	0.00	0.00	0.00	0.25	0.00	0.70
616	3	4.0	29.0	-0.03	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
616	3	3.5	24.0	-0.06	4.0	0.00	0.50	0.00	0.00	0.00	0.25	0.00	0.00	0.25
616	3	3.0	24.0	0.32	8.0	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00	0.25
616	3	2.5	29.0	0.25	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
616	3	2.0	23.0	0.20	5.0	0.00	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00
616	3	1.5	25.0	0.19	5.0	0.25	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.25
616	3	1.0	24.0	0.08	5.0	0.33	0.00	0.34	0.00	0.00	0.33	0.00	0.00	0.00
616	3	0.5	20.0	-0.01	3.0	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
616	3	0.5	4.0	0.03	4.0	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
616	3	1.5	2.0	0.06	9.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	3	2.0	5.0	0.06	9.0	0.00	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00
616	3	2.5	12.0	-0.02	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
616	3	3.0	27.0	0.07	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
616	3	4.0	15.0	0.05	9.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
616	3	3.5	20.0	0.24	9.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	3	3.0	30.0	0.37	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
616	3	2.5	31.0	0.03	11.0	0.45	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.45
616	3	2.0	2.0	0.47	11.0	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.75
616	3	1.5	24.0	-0.03	3.0	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
616	3	1.0	30.0	0.01	4.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
616	3	0.5	23.0	0.08	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
616	3	0.0	8.0	0.53	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	4	0.5	16.0	0.08	3.0	0.30	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
616	4	1.0	22.0	0.06	11.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.75
616	4	1.5	29.0	0.07	11.0	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50
616	4	2.0	25.0	0.10	5.0	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.25
616	4	2.5	5.0	0.38	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
616	4	3.0	31.0	0.07	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.50
616	4	3.5	27.0	0.06	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
616	4	4.0	24.0	-0.05	8.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
616	4	3.5	26.0	0.14	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	4	3.0	25.0	-0.01	9.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	4	2.5	10.0	0.18	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
616	4	2.0	20.0	0.20	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
616	4	1.5	19.0	-0.05	4.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	4	1.0	18.0	0.01	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.50
616	4	0.5	17.0	0.06	9.0	0.00	0.25	0.00	0.00	0.00	0.25	0.50	0.00	0.00
616	4	0.0	13.0	0.10	4.0	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
616	4	0.5	18.0	0.00	3.0	0.35	0.35	0.00	0.00	0.00	0.00	0.30	0.00	0.00
616	4	1.0	17.0	0.11	3.0	0.40	0.40	0.00	0.00	0.00	0.00	0.10	0.00	0.00
616	4	1.5	17.0	0.02	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
616	4	2.0	5.0	-0.01	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
616	4	2.5	10.0	0.24	4.0	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
616	4	3.0	15.0	0.21	4.0	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50
616	4	3.5	15.0	0.01	9.0	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	4	4.0	10.0	0.43	11.0	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.75
616	4	4.5	18.0	0.39	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	4	4.5	20.0	0.34	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	4	3.5	27.0	-0.04	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	4	3.0	38.0	-0.01	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	4	2.5	28.0	0.33	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	4	2.0	27.0	-0.06	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	4	1.5	29.0	-0.09	11.0	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50
616	4	1.0	20.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	4	0.5	12.0	0.12	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
616	4	0.0	5.0	-0.02	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
616	5	0.5	15.0	-0.02	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
616	5	1.0	34.0	0.07	11.0	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.50
616	5	1.5	34.0	0.16	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	5	2.0	29.0	0.30	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	5	2.5	30.0	0.34	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
616	5	3.0	49.0	0.09	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
616	5	3.5	52.0	0.04	11.0	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50
616	5	3.0	36.0	-0.04	11.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.75
616	5	2.5	38.0	-0.09	6.0	0.25	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.25
616	5	2.0	40.0	-0.03	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	5	1.5	31.0	0.11	6.0	0.25	0.00	0.25	0.50	0.00	0.00	0.00	0.00	0.00
616	5	1.0	34.0	0.19	5.0	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00
616	5	0.5	33.0	0.04	5.0	0.30	0.00	0.35	0.35	0.00	0.00	0.00	0.00	0.00
616	5	0.0	33.0	0.03	3.0	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
616	5	0.5	5.0	-0.04	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
616	5	1.0	14.0	-0.02	3.0	0.75	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
616	5	1.5	14.0	0.07	3.0	0.75	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
616	5	2.5	16.0	0.18	8.0	0.00	0.00	0.25	0.00	0.00	0.75	0.00	0.00	0.00
616	5	3.0	17.0	0.25	4.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	5	3.5	8.0	0.00	10.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
616	5	4.0	1.0	0.00	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
616	5	4.5	31.0	0.13	10.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	5	5.0	11.0	0.23	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
616	5	4.5	29.0	0.13	10.0	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00
616	5	4.0	42.0	0.29	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
616	5	3.5	49.0	-0.04	9.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
616	5	3.0	40.0	0.03	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
616	5	2.5	26.0	0.25	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
616	5	2.0	45.0	0.01	9.0	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.00	0.00
616	5	1.5	40.0	0.01	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.50
616	5	1.0	41.0	-0.01	13.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
616	5	0.5	34.0	-0.02	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
616	5	0.0	17.0	-0.03	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
630	1	0.5	7.0	0.00	5.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
630	1	1.0	10.0	0.00	5.0	0.00	0.25	0.50	0.25	0.00	0.00	0.00	0.00	0.00
630	1	1.5	7.0	0.12	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
630	1	2.0	14.0	0.00	8.0	0.00	0.00	0.00	0.50	0.00	0.50	0.00	0.00	0.00
630	1	2.5	16.0	0.00	3.0	0.35	0.00	0.35	0.00	0.00	0.30	0.00	0.00	0.00
630	1	3.5	21.0	0.00	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
630	1	4.0	20.0	0.00	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
630	1	4.5	20.0	0.00	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
630	1	5.0	20.0	0.00	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
630	1	5.5	28.0	0.00	8.0	0.00	0.00	0.25	0.00	0.00	0.75	0.00	0.00	0.00
630	1	6.0	25.0	0.00	8.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
630	1	6.5	25.0	0.00	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
630	1	7.0	21.0	0.00	3.0	0.50	0.25	0.00	0.00	0.00	0.25	0.00	0.00	0.00
630	1	7.5	16.0	0.00	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
630	1	9.0	7.0	0.00	3.0	0.50	0.00	0.00	0.25	0.00	0.25	0.00	0.00	0.00
630	1	9.0	20.0	0.00	3.0	0.35	0.00	0.35	0.00	0.00	0.00	0.30	0.00	0.00
630	1	8.5	4.0	0.00	9.0	0.45	0.00	0.00	0.00	0.00	0.00	0.45	0.00	0.00
630	1	8.0	22.0	0.00	9.0	0.25	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
630	1	7.5	28.0	0.00	9.0	0.25	0.25	0.00	0.00	0.00	0.00	0.40	0.00	0.00
630	1	7.0	28.0	0.00	9.0	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.40
630	1	6.5	39.0	0.00	3.0	0.45	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.20

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
630	1	6.0	34.0	0.00	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
630	1	5.5	50.0	0.00	11.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.50
630	1	5.0	29.0	1.00	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
630	1	4.5	20.0	1.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	1	4.0	22.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	1	3.5	38.0	0.00	11.0	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.90
630	1	3.0	38.0	0.00	11.0	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.90
630	1	2.5	15.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	1	2.0	14.0	1.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	1	1.5	13.0	1.00	11.0	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.95
630	1	1.0	10.0	0.00	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
630	1	0.5	7.0	0.00	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
630	1	0.0	10.0	0.00	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
630	2	0.5	32.0	1.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	2	1.0	32.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
630	2	1.5	34.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
630	2	2.0	31.0	0.00	11.0	0.25	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.40
630	2	1.5	23.0	0.00	3.0	0.75	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.15
630	2	1.0	13.0	0.00	3.0	0.75	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00
630	2	0.0	6.0	0.00	3.0	0.25	0.25	0.00	0.00	0.00	0.25	0.25	0.00	0.00
630	2	0.5	15.0	0.00	3.0	0.34	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00
630	2	1.0	16.0	-0.05	8.0	0.25	0.25	0.25	0.00	0.00	0.25	0.00	0.00	0.00
630	2	1.5	23.0	0.00	8.0	0.00	0.00	0.10	0.00	0.00	0.90	0.00	0.00	0.00
630	2	2.0	27.0	0.00	8.0	0.00	0.40	0.10	0.00	0.00	0.50	0.00	0.00	0.00
630	2	2.5	30.0	0.00	8.0	0.00	0.00	0.25	0.25	0.00	0.50	0.00	0.00	0.00
630	2	3.0	34.0	0.00	6.5	0.00	0.25	0.25	0.40	0.00	0.10	0.00	0.00	0.00
630	2	3.5	39.0	0.00	4.0	0.00	0.25	0.25	0.10	0.00	0.00	0.10	0.00	0.00
630	2	4.0	14.0	0.00	9.0	0.00	0.00	0.00	0.25	0.00	0.00	0.75	0.00	0.00
630	2	4.5	6.0	0.00	8.0	0.00	0.25	0.25	0.25	0.00	0.25	0.00	0.00	0.00
630	2	5.0	8.0	0.00	8.0	0.10	0.10	0.00	0.00	0.00	0.80	0.00	0.00	0.00
630	2	6.0	7.0	0.00	8.0	0.00	0.00	0.25	0.25	0.00	0.50	0.00	0.00	0.00
630	2	7.0	7.0	0.00	9.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
630	2	7.5	23.0	0.00	3.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
630	2	6.5	42.0	0.00	3.0	0.25	0.25	0.00	0.00	0.00	0.25	0.00	0.00	0.25
630	2	6.0	52.0	0.00	4.0	0.25	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.25
630	2	5.5	46.0	0.00	9.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
630	2	5.0	35.0	0.00	9.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
630	2	4.5	46.0	0.00	9.0	0.00	0.00	0.00	0.00	0.00	0.25	0.75	0.00	0.00
630	2	4.0	55.0	0.00	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
630	2	3.5	62.0	0.00	8.0	0.10	0.00	0.00	0.00	0.00	0.75	0.15	0.00	0.00
630	2	3.0	65.0	0.00	11.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.75
630	2	2.5	52.0	0.00	11.0	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80
630	2	2.0	62.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	2	1.5	56.0	0.00	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
630	2	1.0	40.0	0.00	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
630	2	0.5	25.0	0.00	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
630	2	0.0	16.0	0.00	3.0	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
630	3	0.5	13.0	0.00	8.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
630	3	1.0	20.0	0.00	8.0	0.00	0.25	0.00	0.25	0.00	0.50	0.00	0.00	0.00
630	3	1.5	13.0	1.00	9.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
630	3	2.0	5.0	0.00	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
630	3	3.0	8.0	0.00	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
630	3	4.0	5.0	0.00	8.0	0.00	0.25	0.25	0.00	0.00	0.50	0.00	0.00	0.00
630	3	4.5	8.0	0.00	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
630	3	3.0	30.0	0.00	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
630	3	2.5	32.0	0.00	11.0	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.50
630	3	2.0	30.0	0.00	4.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
630	3	1.5	23.0	0.00	8.0	0.00	0.33	0.00	0.33	0.00	0.34	0.00	0.00	0.00
630	3	1.0	9.0	0.00	9.0	0.10	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.00
630	3	0.5	13.0	0.00	8.0	0.00	0.25	0.00	0.25	0.00	0.50	0.00	0.00	0.00
630	3	0.0	6.0	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
630	3	0.5	14.0	0.00	3.0	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00
630	3	1.0	21.0	0.00	3.0	0.00	0.50	0.00	0.00	0.00	0.00	0.50	0.00	0.00
630	3	1.5	9.0	0.00	9.0	0.25	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00
630	3	2.0	34.0	0.00	9.0	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
630	3	3.5	18.0	0.00	9.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
630	3	4.0	5.0	0.00	9.0	0.35	0.00	0.00	0.30	0.00	0.00	0.35	0.00	0.00
630	3	4.5	15.0	0.00	9.0	0.35	0.00	0.00	0.30	0.00	0.00	0.35	0.00	0.00
630	3	4.0	20.0	0.00	8.0	0.00	0.10	0.15	0.00	0.00	0.25	0.25	0.00	0.00
630	3	3.5	15.0	0.00	8.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
630	3	3.0	20.0	0.00	8.0	0.00	0.40	0.10	0.00	0.00	0.00	0.50	0.00	0.00
630	3	2.5	18.0	0.00	8.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
630	3	2.0	29.0	0.00	4.0	0.00	0.40	0.00	0.00	0.00	0.25	0.25	0.00	0.00
630	3	1.0	23.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	3	0.5	12.0	0.69	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	3	0.0	1.0	0.20	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
630	4	0.5	12.0	0.00	6.5	0.00	0.25	0.25	0.50	0.00	0.00	0.00	0.00	0.00
630	4	1.0	11.0	0.00	6.5	0.00	0.00	0.00	0.50	0.00	0.50	0.00	0.00	0.00
630	4	1.5	20.0	0.00	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
630	4	2.0	25.0	0.00	11.0	0.00	0.00	0.33	0.00	0.00	0.33	0.00	0.00	0.34
630	4	2.5	15.0	0.00	5.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
630	4	3.0	25.0	0.00	5.0	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00
630	4	3.5	20.0	0.00	8.0	0.00	0.25	0.25	0.00	0.00	0.50	0.00	0.00	0.00
630	4	4.0	12.0	0.00	8.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
630	4	4.5	23.0	0.00	8.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
630	4	4.5	2.0	0.00	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
630	4	4.0	12.0	0.00	9.0	0.00	0.25	0.00	0.00	0.00	0.25	0.50	0.00	0.00
630	4	3.5	13.0	0.00	9.0	0.00	0.25	0.00	0.00	0.00	0.25	0.50	0.00	0.00
630	4	3.0	14.0	0.00	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
630	4	2.5	10.0	0.00	8.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
630	4	2.0	11.0	0.00	8.0	0.00	0.25	0.25	0.00	0.00	0.50	0.00	0.00	0.00
630	4	1.5	10.0	0.00	8.0	0.00	0.25	0.25	0.00	0.00	0.50	0.00	0.00	0.00
630	4	1.0	18.0	0.00	4.0	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00
630	4	0.5	9.0	0.00	8.0	0.25	0.25	0.00	0.00	0.00	0.00	0.50	0.00	0.00
630	4	0.0	10.0	0.00	8.0	0.00	0.25	0.25	0.00	0.00	0.50	0.00	0.00	0.00
630	4	0.5	6.0	0.00	9.0	0.10	0.15	0.00	0.00	0.00	0.00	0.75	0.00	0.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
630	4	1.0	10.0	0.00	4.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
630	4	1.5	15.0	0.00	9.0	0.00	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00
630	4	2.0	14.0	0.35	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
630	4	2.5	34.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.75
630	4	3.0	35.0	0.09	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	4	3.5	22.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	4	3.5	20.0	0.04	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
630	4	3.0	14.0	0.15	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	4	2.5	10.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	4	2.0	5.0	0.51	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
630	4	1.5	17.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	4	1.0	10.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	4	0.5	6.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	4	0.0	2.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	0.5	10.0	0.00	3.0	0.75	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00
630	5	1.0	0.0	0.04	8.0	0.00	0.00	0.25	0.00	0.00	0.75	0.00	0.00	0.00
630	5	1.5	23.0	0.00	5.0	0.00	0.35	0.35	0.00	0.00	0.30	0.00	0.00	0.00
630	5	2.0	20.0	0.13	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	2.5	25.0	0.07	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	3.0	25.0	0.03	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	3.5	26.0	0.08	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	4.0	41.0	-0.03	4.0	0.00	0.50	0.00	0.00	0.00	0.50	0.00	0.00	0.00
630	5	4.0	35.0	-0.02	5.0	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00
630	5	3.5	31.0	0.03	4.0	0.00	0.50	0.00	0.00	0.00	0.25	0.00	0.00	0.00
630	5	3.0	30.0	0.07	8.0	0.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00
630	5	2.5	28.0	0.00	8.0	0.00	0.00	0.50	0.00	0.00	0.50	0.00	0.00	0.00
630	5	2.0	26.0	0.00	5.0	0.00	0.35	0.35	0.00	0.00	0.25	0.00	0.00	0.00
630	5	1.5	10.0	0.10	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
630	5	0.0	22.0	0.00	3.0	0.75	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00
630	5	0.5	8.0	0.00	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
630	5	1.0	23.0	-0.03	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
630	5	1.5	29.0	0.00	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
630	5	2.5	43.0	0.00	3.0	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
630	5	3.0	20.0	0.02	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	3.5	30.0	0.19	11.0	0.10	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.75
630	5	4.0	24.0	-0.03	11.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.50
630	5	4.5	11.0	0.40	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	5.0	20.0	0.02	11.0	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.50
630	5	4.5	11.0	0.14	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	4.0	12.0	0.77	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	3.5	10.0	0.20	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	3.0	12.0	0.30	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	2.5	4.0	0.74	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	2.0	5.0	0.67	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	1.5	5.0	0.13	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	1.0	5.0	0.43	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	0.5	5.0	0.37	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
630	5	0.0	3.0	0.14	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
717	1	0.5	25.0	0.11	11.0	0.00	0.00	0.25	0.00	0.00	0.25	0.00	0.00	0.50
717	1	1.0	10.0	0.06	9.0	0.25	0.00	0.25	0.00	0.00	0.00	0.50	0.00	0.00
717	1	2.0	29.0	0.00	4.0	0.25	0.40	0.00	0.00	0.00	0.00	0.10	0.00	0.00
717	1	2.5	29.0	0.03	11.0	0.45	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.45
717	1	3.0	51.0	-0.08	11.0	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
717	1	3.5	26.0	0.19	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
717	1	3.0	1.0	5.24	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
717	1	2.5	16.0	0.26	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
717	1	2.0	20.0	0.22	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
717	1	1.5	52.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
717	1	1.0	22.0	0.21	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
717	1	0.5	16.0	0.01	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
717	1	0.0	10.0	0.00	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
717	2	0.5	18.0	0.00	3.0	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
717	2	1.0	25.0	0.00	3.0	0.90	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00
717	2	1.5	30.0	0.00	3.0	0.45	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
717	2	2.0	30.0	0.04	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
717	2	2.5	35.0	0.00	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
717	2	3.0	46.0	0.04	11.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.50
717	2	3.5	20.0	0.27	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
717	2	4.0	19.0	0.15	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
717	2	4.0	15.0	0.24	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
717	2	3.5	50.0	0.24	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
717	2	3.0	17.0	0.27	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
717	2	2.5	22.0	0.06	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
717	2	2.0	22.0	-0.06	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
717	2	1.5	16.0	0.13	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
717	2	1.0	26.0	0.11	11.0	0.10	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.50
717	2	0.5	12.0	0.11	11.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
717	2	0.0	6.0	0.01	11.0	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
717	3	0.5	42.0	0.00	9.0	0.10	0.00	0.00	0.00	0.00	0.00	0.90	0.00	0.00
717	3	1.0	40.0	0.11	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
717	3	1.5	35.0	0.02	9.0	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00
717	3	2.5	20.0	0.08	9.0	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.00
717	3	3.5	34.0	0.10	9.0	0.15	0.00	0.10	0.00	0.00	0.00	0.75	0.00	0.00
717	3	4.0	45.0	0.01	9.0	0.15	0.00	0.10	0.00	0.00	0.00	0.75	0.00	0.00
717	3	4.5	20.0	0.21	9.0	0.00	0.25	0.00	0.00	0.00	0.00	0.75	0.00	0.00
717	3	5.0	42.0	0.07	9.0	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00
717	3	5.5	40.0	-0.05	9.0	0.00	0.15	0.00	0.00	0.00	0.00	0.75	0.00	0.00
717	3	6.0	40.0	-0.02	9.0	0.35	0.00	0.10	0.00	0.00	0.00	0.55	0.00	0.00
717	3	5.5	17.0	0.00	9.0	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00
717	3	5.0	30.0	0.18	9.0	0.25	0.00	0.00	0.25	0.00	0.00	0.50	0.00	0.00
717	3	4.5	35.0	0.00	10.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.00
717	3	3.5	45.0	0.03	9.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
717	3	2.0	14.0	0.04	4.0	0.00	0.35	0.35	0.00	0.00	0.30	0.00	0.00	0.00
717	3	1.5	24.0	-0.11	9.0	0.25	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.00
717	3	1.0	33.0	0.00	3.0	0.25	0.15	0.00	0.00	0.00	0.00	0.25	0.00	0.25
717	3	0.5	42.0	0.00	5.0	0.10	0.00	0.45	0.00	0.00	0.00	0.00	0.00	0.00

Date	Trsct	Dist	Depth	Velocity	Phi	Sand	Fine Grvl	Coarse Grvl	Pebble	Rubble	Cobble	Small Bldr	Large Bldr	Bedrock
717	3	0.0	13.0	0.01	3.0	0.90	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
717	4	0.5	7.0	0.02	9.0	0.25	0.00	0.25	0.00	0.00	0.00	0.50	0.00	0.00
717	4	1.0	15.0	0.00	4.0	0.00	0.50	0.00	0.00	0.00	0.25	0.25	0.00	0.00
717	4	1.5	25.0	0.00	9.0	0.05	0.05	0.00	0.00	0.00	0.00	0.15	0.00	0.00
717	4	2.0	24.0	0.10	11.0	0.25	0.25	0.00	0.00	0.00	0.25	0.00	0.00	0.25
717	4	2.5	27.0	0.01	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
717	4	3.0	24.0	0.30	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
717	4	3.5	24.0	0.44	11.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
717	4	4.0	21.0	0.08	11.0	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.75
717	4	4.5	19.0	0.10	11.0	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.50
717	4	4.0	20.0	0.04	11.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.75
717	4	3.5	15.0	0.24	11.0	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.75
717	4	3.0	25.0	0.20	8.0	0.00	0.00	0.00	0.50	0.00	0.50	0.00	0.00	0.00
717	4	2.5	20.0	0.08	6.0	0.00	0.00	0.00	0.50	0.00	0.50	0.00	0.00	0.00
717	4	2.0	30.0	0.14	8.0	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00
717	4	1.5	36.0	0.04	8.0	0.00	0.25	0.00	0.00	0.00	0.50	0.25	0.00	0.00
717	4	1.0	32.0	-0.02	8.0	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
717	4	0.5	17.0	0.06	11.0	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90
717	4	0.0	6.0	0.02	11.0	0.30	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.35
717	5	0.5	26.0	0.00	9.0	0.15	0.10	0.00	0.00	0.00	0.00	0.75	0.00	0.00
717	5	1.5	30.0	0.04	9.0	0.25	0.25	0.25	0.00	0.00	0.00	0.25	0.00	0.00
717	5	2.0	20.0	0.22	9.0	0.10	0.05	0.00	0.00	0.00	0.00	0.75	0.00	0.00
717	5	2.5	15.0	0.09	9.0	0.25	0.00	0.00	0.00	0.00	0.25	0.50	0.00	0.00
717	5	3.0	18.0	0.06	9.0	0.00	0.25	0.00	0.25	0.00	0.00	0.50	0.00	0.00
717	5	3.5	18.0	0.24	9.0	0.10	0.00	0.00	0.15	0.00	0.00	0.75	0.00	0.00
717	5	4.0	17.0	0.05	6.0	0.00	0.00	0.00	0.50	0.00	0.50	0.00	0.00	0.00
717	5	4.0	25.0	0.00	6.0	0.00	0.00	0.00	0.50	0.00	0.50	0.00	0.00	0.00
717	5	3.5	4.0	0.04	9.0	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
717	5	3.0	25.0	0.19	9.0	0.00	0.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00
717	5	2.5	23.0	0.02	9.0	0.25	0.00	0.00	0.25	0.00	0.00	0.50	0.00	0.00
717	5	2.0	24.0	0.05	9.0	0.50	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00
717	5	1.5	29.0	0.20	8.0	0.25	0.25	0.00	0.00	0.00	0.50	0.00	0.00	0.00
717	5	1.0	25.0	0.08	8.0	0.25	0.25	0.00	0.00	0.00	0.50	0.00	0.00	0.00
717	5	0.5	20.0	0.01	3.0	0.75	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00
717	5	0.0	14.0	0.04	3.0	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10

APPENDIX B. Abundances of Herbivores in 0.25 m^2 quadrats at Big Elk Creek Study Area, March 20 - July 17, 1986. Abreviations are: Trsct = transect; Dist = distance from bank; Phi = phi scale for substrate size; Grvl = gravel; Bldr = Boulder.

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
320	1	0.5	0.0	0.0	0.0	0	33	18	0.0	0.0	0	0
320	1	1.0	0.0	0.0	0.0	0	70	62	0.0	0.0	0	0
320	1	1.5	0.0	0.0	0.0	0	15	14	0.0	0.0	0	0
320	1	2.0	0.0	0.0	0.0	0	0	25	0.0	0.0	0	0
320	1	2.5	0.0	0.0	0.0	0	0	24	0.0	0.0	0	0
320	1	3.0	0.0	0.0	0.0	0	0	21	0.0	0.0	0	0
320	1	3.5	0.0	0.0	0.0	0	0	5	0.0	0.0	0	0
320	1	4.0	0.0	0.0	0.0	0	0	12	0.0	0.0	0	0
320	1	4.5	0.0	0.0	0.0	0	0	7	0.0	0.0	0	0
320	1	5.0	0.0	0.0	0.0	0	0	6	0.0	0.0	0	0
320	1	5.5	0.0	0.0	0.0	0	3	25	0.0	0.0	0	0
320	1	6.0	0.0	0.0	0.0	0	6	0	0.0	0.0	0	0
320	1	6.5	0.0	0.0	0.0	0	2	10	0.0	0.0	0	0
320	1	7.0	0.0	0.0	0.0	0	0	3	0.0	0.0	0	0
320	1	7.5	0.0	0.0	0.0	0	0	14	0.0	0.0	0	0
320	1	8.0	0.0	0.0	0.0	0	6	7	0.0	0.0	0	0
320	1	8.5	0.0	0.0	0.0	0	1	7	0.0	0.0	0	0
320	1	9.0	0.0	0.0	0.0	0	1	0	0.0	0.0	0	0
320	1	9.5	0.0	0.0	0.0	0	7	0	0.0	0.0	0	0
320	1	10.0	0.0	0.0	0.0	0	2	4	0.0	0.0	0	0
320	1	10.5	0.0	0.0	0.0	0	0	10	0.0	0.0	0	0
320	1	11.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
320	1	11.5	0.0	0.0	0.0	0	18	0	0.0	0.0	0	0
320	1	11.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
320	3	0.5	0.0	0.0	0.0	0	14	2	0.0	0.0	0	0
320	3	1.0	0.0	0.0	0.0	0	11	4	0.0	0.0	0	0
320	3	1.5	0.0	0.0	0.0	0	1	0	0.0	0.0	0	0
320	3	2.0	0.0	0.0	0.0	0	0	3	0.0	0.0	0	0
320	3	2.5	0.0	0.0	0.0	0	0	5	0.0	0.0	0	0
320	3	3.0	0.0	0.0	0.0	0	0	2	0.0	0.0	0	0
320	3	3.5	0.0	0.0	0.0	0	0	5	0.0	0.0	0	0
320	3	4.0	0.0	0.0	0.0	0	1	2	0.0	0.0	0	0
320	3	4.5	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
320	3	5.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
320	3	5.5	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
320	3	6.0	0.0	0.0	0.0	0	0	7	0.0	0.0	0	0
320	3	6.5	0.0	0.0	0.0	0	0	9	0.0	0.0	0	0
320	3	5.5	0.0	0.0	0.0	0	0	5	0.0	0.0	0	0
320	3	5.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
320	3	4.5	0.0	0.0	0.0	0	0	6	0.0	0.0	0	0
320	3	4.0	0.0	0.0	0.0	0	0	1	0.0	0.0	0	0
320	3	3.5	0.0	0.0	0.0	0	0	5	0.0	0.0	0	0
320	3	3.0	0.0	0.0	0.0	0	0	5	0.0	0.0	0	0
320	3	2.5	0.0	0.0	0.0	0	28	20	0.0	0.0	0	0
320	3	2.0	0.0	0.0	0.0	0	11	8	0.0	0.0	0	0
320	3	1.0	0.0	0.0	0.0	0	3	3	0.0	0.0	0	0
320	3	0.5	1.0	0.0	0.0	0	2	8	0.0	0.0	0	0
320	3	0.0	11.0	0.0	0.0	0	7	12	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
320	3	1.0	0.0	0.0	0.0	0	2	7	0.0	0.0	0	0
320	3	1.5	0.0	0.0	0.0	0	2	1	0.0	0.0	0	0
320	3	2.0	0.0	0.0	0.0	0	0	3	0.0	0.0	0	0
320	3	2.5	0.0	0.0	0.0	0	4	0	0.0	0.0	0	0
320	3	3.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
320	4	0.5	0.0	0.0	0.0	0	30	29	0.0	0.0	0	0
320	4	1.0	0.0	0.0	0.0	0	31	12	0.0	0.0	0	0
320	4	1.5	0.0	0.0	0.0	0	28	71	0.0	0.0	0	0
320	4	3.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
320	4	2.5	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
320	4	1.5	0.0	0.0	0.0	0	37	55	0.0	0.0	0	0
320	4	1.0	0.0	0.0	0.0	0	25	34	0.0	0.0	0	0
320	4	0.5	0.0	0.0	0.0	0	10	6	0.0	0.0	0	0
320	4	0.0	4.0	0.0	0.0	0	18	0	0.0	0.0	0	0
320	4	0.0	0.0	0.0	0.0	0	0	1	0.0	0.0	0	0
320	4	0.5	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
320	4	1.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
320	4	1.5	0.0	0.0	0.0	0	8	11	0.0	0.0	0	0
320	4	2.0	0.0	0.0	0.0	0	13	6	0.0	0.0	0	0
320	5	2.5	0.0	0.0	0.0	0	38	68	0.0	0.0	0	0
320	5	2.0	5.0	0.0	0.0	0	35	74	0.0	0.0	0	0
320	5	1.5	2.0	0.0	0.0	0	48	29	0.0	0.0	0	0
320	5	1.0	2.0	0.0	0.0	0	31	33	0.0	0.0	0	0
320	5	0.5	0.0	0.0	0.0	0	60	35	0.0	0.0	0	0
320	5	0.0	0.0	0.0	0.0	0	35	19	0.0	0.0	0	0
410	1	2.0	0.0	0.0	0.0	0	7	26	0.0	0.0	0	0
410	1	2.5	0.0	0.0	0.0	0	4	15	0.0	0.0	0	0
410	1	4.3	0.0	0.0	0.0	0	5	10	0.0	0.0	0	0
410	1	9.5	0.0	0.0	0.0	0	22	11	0.0	0.0	0	0
410	1	8.5	1.0	0.0	0.0	0	0	6	0.0	0.0	0	0
410	1	8.0	1.0	0.0	0.0	0	0	0	0.0	0.0	0	0
410	1	7.5	2.0	0.0	0.0	0	0	2	0.0	0.0	0	0
410	1	7.0	1.0	1.0	0.0	0	0	5	0.0	0.0	0	0
410	1	6.5	2.0	0.0	0.0	0	0	10	0.0	2.0	0	0
410	1	6.0	7.0	0.0	0.0	0	1	5	0.0	1.0	0	0
410	1	5.5	15.0	0.0	0.0	0	33	3	0.0	0.0	0	0
410	1	5.0	0.0	0.0	0.0	0	30	3	0.0	0.0	0	0
410	1	4.5	0.0	0.0	0.0	0	7	0	0.0	0.0	0	0
410	2	0.0	2.0	0.0	0.0	0	4	0	0.0	0.0	0	0
410	2	0.5	0.0	0.0	0.0	0	14	0	0.0	0.0	0	0
410	2	1.0	0.0	0.0	0.0	0	14	0	0.0	0.0	0	0
410	2	1.5	1.0	0.0	0.0	0	20	4	0.0	0.0	0	0
410	2	2.0	12.0	0.0	0.0	0	8	1	0.0	0.0	0	0
410	2	2.5	5.0	0.0	0.0	0	12	9	0.0	1.0	0	0
410	2	3.0	2.0	0.0	0.0	0	8	8	0.0	0.0	0	0
410	2	3.5	0.0	0.0	0.0	0	7	6	0.0	0.0	0	0
410	2	4.0	0.0	0.0	0.0	0	8	8	0.0	0.0	0	0
410	2	4.5	0.0	0.0	0.0	0	4	8	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
410	3	0.0	0.0	0.0	0.0	0	12	38	0.0	0.0	0	0
410	3	0.5	6.0	1.0	0.0	0	19	21	0.0	0.0	0	0
410	3	1.0	11.0	0.0	0.0	0	13	24	0.0	3.0	0	0
410	3	3.0	7.0	0.0	0.0	0	17	12	0.0	3.0	0	0
410	3	3.5	0.0	2.0	0.0	0	29	18	0.0	0.0	0	0
410	3	4.0	0.0	0.0	0.0	0	17	4	0.0	6.0	0	0
410	3	1.5	0.0	0.0	0.0	0	0	1	0.0	0.0	0	0
410	3	1.0	1.0	0.0	0.0	0	0	0	0.0	0.0	0	0
410	3	0.5	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
410	3	0.0	1.0	0.0	0.0	0	5	0	0.0	0.0	0	0
410	4	0.0	2.0	0.0	0.0	0	9	18	0.0	2.0	0	0
410	4	1.0	4.0	0.0	0.0	0	13	13	0.0	2.0	0	1
410	4	4.5	1.0	0.0	0.0	0	7	1	0.0	0.0	0	3
410	4	5.0	6.0	3.0	0.0	0	7	2	0.0	0.0	0	0
410	4	5.5	9.0	0.0	0.0	0	5	0	0.0	5.0	0	0
410	4	6.0	1.0	1.0	0.0	0	11	0	0.0	0.0	0	0
410	4	6.5	1.0	0.0	0.0	0	7	0	0.0	1.0	0	0
410	4	7.0	0.0	0.0	0.0	0	5	3	0.0	1.0	0	0
410	4	6.5	0.0	1.0	0.0	0	6	5	0.0	7.0	0	0
410	4	1.0	0.0	0.0	0.0	0	57	3	0.0	0.0	0	0
410	4	0.5	14.0	0.0	0.0	0	59	0	0.0	0.0	0	0
410	4	0.0	0.0	0.0	0.0	0	8	0	0.0	0.0	0	0
422	1	0.5	0.0	0.0	0.0	0	32	0	0.0	0.0	0	0
422	1	1.0	0.0	0.0	0.0	0	18	9	0.0	0.0	0	1
422	1	1.5	0.0	0.0	0.0	0	21	23	0.0	0.0	0	0
422	1	2.0	0.0	0.0	0.0	0	25	13	0.0	0.0	0	3
422	1	2.5	0.0	0.0	0.0	0	64	12	0.0	0.0	0	2
422	1	3.0	0.0	0.0	0.0	0	52	24	0.0	0.0	0	0
422	1	3.5	0.0	0.0	0.0	0	18	11	0.0	0.0	0	0
422	1	4.0	0.0	0.0	0.0	0	16	4	0.0	0.0	2	0
422	1	4.5	0.0	0.0	0.0	0	10	0	0.0	0.0	0	0
422	1	5.0	0.0	0.0	0.0	0	41	0	0.0	0.0	0	0
422	1	5.5	0.0	0.0	0.0	0	31	2	0.0	0.0	0	0
422	1	6.0	0.0	0.0	0.0	0	24	5	0.0	0.0	0	0
422	1	6.5	0.0	0.0	0.0	0	20	15	0.0	0.0	0	0
422	1	7.0	0.0	0.0	0.0	0	15	16	0.0	0.0	0	0
422	1	7.5	0.0	0.0	0.0	0	18	15	0.0	0.0	0	0
422	1	8.0	0.0	0.0	0.0	0	21	10	0.0	0.0	0	0
422	1	8.5	0.0	0.0	0.0	0	11	1	0.0	0.0	0	0
422	1	9.0	0.0	0.0	0.0	0	3	0	0.0	0.0	0	0
422	1	9.5	0.0	0.0	0.0	0	14	13	0.0	0.0	0	0
422	1	10.0	0.0	0.0	0.0	0	19	12	0.0	0.0	0	0
422	1	10.5	0.0	0.0	0.0	0	8	15	0.0	0.0	0	0
422	1	11.0	0.0	0.0	0.0	0	19	31	0.0	0.0	0	0
422	1	10.0	0.0	0.0	0.0	0	12	9	0.0	0.0	0	0
422	1	9.5	0.0	0.0	0.0	0	11	12	0.0	0.0	0	0
422	1	9.0	0.0	0.0	0.0	0	8	6	0.0	0.0	0	0
422	1	8.5	0.0	0.0	0.0	0	0	2	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
422	1	8.0	0.0	0.0	0.0	0	11	8	0.0	0.0	0	0
422	1	7.5	0.0	0.0	0.0	0	4	10	0.0	0.0	0	0
422	1	7.0	0.0	0.0	0.0	0	0	1	0.0	0.0	0	0
422	1	6.5	0.0	0.0	0.0	0	5	9	0.0	0.0	0	0
422	1	6.0	0.0	0.0	0.0	0	6	10	0.0	0.0	0	0
422	1	5.5	0.0	1.0	0.0	0	4	4	0.0	0.0	0	0
422	1	4.0	0.0	1.0	0.0	0	0	1	0.0	0.0	0	0
422	1	3.5	0.0	5.0	0.0	0	0	4	0.0	0.0	0	0
422	1	3.0	1.0	14.0	0.0	0	3	14	0.0	0.0	0	0
422	1	2.5	0.0	13.0	0.0	0	1	9	0.0	0.0	0	0
422	1	2.0	3.0	4.0	0.0	0	0	0	0.0	0.0	9	0
422	1	1.5	9.0	2.0	0.0	0	30	16	0.0	0.0	0	0
422	1	0.5	12.0	0.0	0.0	0	12	9	0.0	0.0	0	0
422	1	0.0	1.0	0.0	0.0	0	13	4	0.0	0.0	0	0
422	2	0.5	0.0	0.0	0.0	0	14	11	0.0	0.0	0	0
422	2	1.0	0.0	0.0	0.0	0	5	0	0.0	0.0	0	0
422	2	2.0	0.0	0.0	0.0	0	9	3	0.0	0.0	0	0
422	2	2.5	0.0	0.0	0.0	0	17	9	0.0	0.0	0	0
422	2	3.0	0.0	0.0	0.0	0	31	11	0.0	0.0	0	0
422	2	3.5	0.0	0.0	0.0	0	25	3	0.0	0.0	0	0
422	2	4.0	0.0	0.0	0.0	0	17	12	0.0	0.0	11	0
422	2	4.5	0.0	0.0	0.0	0	21	11	0.0	0.0	4	0
422	2	5.0	0.0	0.0	0.0	0	46	32	0.0	0.0	2	0
422	2	5.5	0.0	0.0	0.0	0	60	34	0.0	0.0	0	0
422	2	6.0	0.0	0.0	0.0	0	19	30	0.0	0.0	2	2
422	2	6.5	0.0	0.0	0.0	0	29	30	0.0	0.0	5	0
422	2	7.5	0.0	0.0	0.0	0	15	7	0.0	0.0	9	0
422	2	8.0	0.0	0.0	0.0	0	62	20	0.0	0.0	4	3
422	2	9.0	0.0	0.0	0.0	0	24	24	0.0	0.0	0	1
422	2	9.5	0.0	0.0	0.0	0	28	14	0.0	0.0	0	0
422	2	10.0	0.0	0.0	0.0	0	11	23	0.0	0.0	0	0
422	2	10.5	0.0	0.0	0.0	0	21	14	0.0	0.0	1	0
422	2	11.0	0.0	0.0	0.0	0	15	7	0.0	0.0	2	0
422	2	11.5	0.0	1.0	0.0	0	23	39	0.0	0.0	0	0
422	2	11.5	0.0	0.0	0.0	0	19	37	0.0	0.0	0	0
422	2	11.0	0.0	0.0	0.0	0	30	14	0.0	0.0	0	0
422	2	10.5	0.0	0.0	0.0	0	27	7	0.0	0.0	0	0
422	2	10.0	0.0	0.0	0.0	0	23	6	0.0	0.0	0	0
422	2	9.5	0.0	0.0	0.0	0	15	3	0.0	0.0	0	0
422	2	9.0	0.0	0.0	0.0	0	8	5	0.0	0.0	0	0
422	2	8.5	0.0	0.0	0.0	0	6	1	0.0	0.0	0	0
422	2	8.0	0.0	0.0	0.0	0	9	7	0.0	0.0	0	0
422	2	7.5	0.0	0.0	0.0	0	8	3	0.0	0.0	0	0
422	2	7.0	0.0	0.0	0.0	0	6	1	0.0	0.0	0	0
422	2	6.5	0.0	0.0	0.0	0	7	4	0.0	0.0	0	0
422	2	6.0	0.0	0.0	0.0	0	8	4	0.0	0.0	0	0
422	2	5.5	0.0	0.0	0.0	0	2	0	0.0	0.0	0	0
422	2	3.0	0.0	0.0	0.0	0	13	15	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
422	2	2.5	0.0	0.0	0.0	0	4	4	0.0	0.0	0	0
422	2	2.0	0.0	0.0	0.0	0	9	19	0.0	0.0	0	0
422	2	1.5	0.0	0.0	0.0	0	12	17	0.0	0.0	0	0
422	2	1.0	0.0	0.0	0.0	0	9	4	0.0	0.0	0	0
422	2	0.5	0.0	0.0	0.0	0	14	13	0.0	0.0	0	0
422	2	0.0	0.0	0.0	0.0	0	4	1	0.0	0.0	0	0
514	1	0.5	0.0	0.0	0.0	0	8	6	0.0	0.0	0	0
514	1	1.0	1.0	0.0	0.0	0	34	11	14.0	0.0	0	0
514	1	1.5	0.0	0.0	0.0	0	39	6	70.0	0.0	0	0
514	1	2.0	0.0	0.0	0.0	0	47	10	0.0	5.0	0	0
514	1	2.5	0.0	0.0	0.0	0	54	12	280.0	0.0	0	0
514	1	3.0	0.0	0.0	0.0	0	39	7	285.0	0.0	0	0
514	1	3.5	0.0	0.0	0.0	0	50	7	60.0	0.0	0	0
514	1	4.0	0.0	0.0	0.0	0	59	16	10.0	0.0	0	0
514	1	4.5	0.0	0.0	0.0	0	60	7	0.0	0.0	0	0
514	1	5.0	0.0	0.0	0.0	0	25	0	0.0	0.0	0	0
514	1	5.5	0.0	0.0	0.0	0	22	0	0.0	0.0	0	0
514	1	6.0	0.0	0.0	0.0	0	53	8	16.0	0.0	0	0
514	1	6.5	0.0	0.0	0.0	0	43	6	0.0	0.0	0	0
514	1	7.0	0.0	0.0	0.0	0	10	0	0.0	0.0	0	0
514	1	7.5	0.0	0.0	0.0	0	15	6	0.0	0.0	0	0
514	1	8.0	0.0	0.0	0.0	0	20	14	0.0	0.0	0	0
514	1	8.5	0.0	0.0	0.0	0	24	10	0.0	0.0	0	0
514	1	9.0	0.0	0.0	0.0	0	20	20	0.0	0.0	0	0
514	1	9.5	0.0	0.0	0.0	0	27	10	0.0	0.0	0	0
514	1	10.0	0.0	0.0	0.0	0	12	11	0.0	0.0	0	0
514	1	10.5	0.0	0.0	0.0	0	12	7	0.0	0.0	0	0
514	1	11.0	0.0	0.0	0.0	0	7	9	0.0	0.0	0	0
514	1	8.5	0.0	0.0	0.0	0	7	16	0.0	0.0	0	0
514	1	8.0	0.0	0.0	0.0	0	11	28	0.0	2.0	0	0
514	1	7.5	0.0	0.0	0.0	0	12	24	0.0	0.0	0	0
514	1	6.0	0.0	0.0	0.0	0	8	14	0.0	0.0	0	0
514	1	5.5	0.0	0.0	0.0	0	4	10	0.0	0.0	0	0
514	1	5.0	0.0	0.0	0.0	0	2	4	0.0	0.0	0	0
514	1	4.5	0.0	0.0	1.0	0	1	0	0.0	0.0	0	0
514	1	4.0	0.0	0.0	3.0	0	1	0	0.0	0.0	0	0
514	1	3.5	0.0	1.0	7.0	0	0	0	0.0	0.0	0	0
514	1	3.0	0.0	1.0	9.0	0	0	2	0.0	0.0	0	0
514	1	3.5	0.0	3.0	14.0	0	5	0	0.0	0.0	0	2
514	1	2.0	0.0	0.0	11.0	0	9	7	0.0	0.0	0	0
514	1	2.5	0.0	1.0	10.0	0	10	10	0.0	0.0	0	0
514	1	1.0	0.0	3.0	8.0	0	7	6	0.0	0.0	0	0
514	1	1.5	0.0	3.0	12.0	0	6	10	0.0	0.0	0	0
514	1	0.5	1.0	8.0	2.0	0	4	0	0.0	0.0	0	0
514	1	0.0	1.0	0.0	0.0	0	16	7	0.0	0.0	0	0
514	2	0.5	0.0	0.0	0.0	0	8	11	0.0	0.0	0	0
514	2	1.0	0.0	0.0	0.0	0	24	4	0.0	0.0	0	0
514	2	1.5	0.0	0.0	0.0	0	16	0	0.0	2.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
514	2	2.0	0.0	0.0	0.0	0	17	0	0.0	0.0	0	0
514	2	2.5	0.0	0.0	0.0	0	17	5	0.0	3.0	0	0
514	2	3.0	0.0	0.0	0.0	0	30	6	0.0	6.0	0	0
514	2	3.5	0.0	0.0	0.0	0	25	5	0.0	5.0	0	0
514	2	4.0	0.0	0.0	0.0	0	20	6	15.0	0.0	0	0
514	2	4.5	0.0	0.0	0.0	0	18	2	8.0	0.0	0	0
514	2	5.0	0.0	0.0	0.0	0	10	4	0.0	0.0	0	0
514	2	5.5	0.0	0.0	0.0	0	20	10	0.0	2.0	0	0
514	2	6.0	0.0	0.0	0.0	0	4	9	40.0	0.0	1	1
514	2	6.5	0.0	0.0	0.0	0	5	0	0.0	2.0	0	0
514	2	7.0	0.0	0.0	0.0	0	16	9	80.0	0.0	0	0
514	2	7.5	0.0	0.0	1.0	0	13	6	0.0	48.0	0	0
514	2	8.0	0.0	0.0	0.0	0	25	23	48.0	0.0	0	0
514	2	8.5	0.0	1.0	0.0	0	22	26	23.0	0.0	0	2
514	2	9.0	0.0	0.0	0.0	0	0	2	0.0	0.0	0	1
514	2	9.5	1.0	0.0	1.0	0	5	2	30.0	0.0	0	0
514	2	10.0	0.0	0.0	0.0	0	10	5	23.0	0.0	0	0
514	2	10.5	0.0	0.0	0.0	0	9	6	18.0	0.0	0	0
514	2	11.0	0.0	0.0	0.0	0	20	3	0.0	8.0	0	0
514	2	11.0	0.0	0.0	0.0	0	9	7	0.0	5.0	0	0
514	2	9.0	1.0	3.0	0.0	0	14	5	0.0	0.0	0	2
514	2	8.5	0.0	4.0	2.0	0	11	7	16.0	0.0	0	0
514	2	8.0	0.0	0.0	1.0	0	26	3	21.0	0.0	0	0
514	2	7.5	0.0	0.0	1.0	0	25	15	20.0	20.0	0	0
514	2	7.0	0.0	0.0	0.0	0	22	7	0.0	0.0	0	0
514	2	6.5	0.0	0.0	0.0	0	9	9	0.0	0.0	0	0
514	2	6.0	0.0	0.0	0.0	0	16	11	0.0	0.0	0	0
514	2	5.5	0.0	0.0	0.0	0	1	2	0.0	1.0	0	0
514	2	5.0	0.0	0.0	0.0	0	1	1	0.0	0.0	0	0
514	2	4.5	0.0	0.0	0.0	0	2	3	0.0	0.0	0	0
514	2	4.0	0.0	0.0	0.0	0	2	0	0.0	0.0	0	0
514	2	3.5	0.0	0.0	0.0	0	4	2	0.0	0.0	0	0
514	2	3.0	0.0	0.0	0.0	0	9	9	0.0	0.0	0	0
514	2	2.5	0.0	0.0	0.0	0	2	9	0.0	0.0	0	0
514	2	2.0	0.0	0.0	0.0	0	0	0	110.0	0.0	0	0
514	2	1.5	0.0	0.0	0.0	0	0	4	30.0	13.0	0	0
514	2	1.0	0.0	0.0	0.0	0	7	5	0.0	30.0	0	0
514	2	0.5	0.0	0.0	0.0	0	59	2	0.0	0.0	0	0
514	2	0.0	0.0	0.0	0.0	0	13	5	0.0	0.0	0	0
514	3	0.5	0.0	0.0	0.0	0	29	8	0.0	0.0	0	0
514	3	1.0	0.0	0.0	0.0	0	21	5	0.0	8.0	0	0
514	3	1.5	0.0	0.0	0.0	0	21	5	8.0	9.0	0	0
514	3	2.0	0.0	0.0	0.0	0	10	1	0.0	0.0	0	0
514	3	2.5	0.0	0.0	0.0	0	18	2	0.0	0.0	0	0
514	3	3.0	0.0	0.0	0.0	0	12	2	0.0	0.0	0	0
514	3	3.5	0.0	0.0	0.0	0	10	3	24.0	0.0	0	0
514	3	4.0	0.0	0.0	0.0	0	14	4	28.0	0.0	0	0
514	3	4.5	0.0	0.0	0.0	0	11	6	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho· glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
514	3	5.0	0.0	1.0	0.0	0	9	3	0.0	0.0	0	0
514	3	5.5	0.0	0.0	1.0	0	1	0	54.0	0.0	4	0
514	3	6.0	0.0	2.0	2.0	0	5	4	125.0	23.0	0	0
514	3	6.5	0.0	0.0	0.0	0	4	4	160.0	0.0	9	0
514	3	7.5	0.0	0.0	0.0	0	6	6	110.0	0.0	0	0
514	3	8.0	0.0	0.0	0.0	0	3	1	70.0	0.0	0	0
514	3	8.5	0.0	0.0	0.0	0	4	6	19.0	0.0	0	1
514	3	9.0	0.0	0.0	1.0	0	5	8	17.0	0.0	1	0
514	3	9.5	0.0	0.0	0.0	0	1	3	15.0	0.0	0	0
514	3	10.0	0.0	0.0	2.0	0	10	8	20.0	0.0	0	0
514	3	10.5	0.0	0.0	0.0	0	2	0	20.0	0.0	0	0
514	3	11.0	0.0	0.0	1.0	0	0	9	40.0	0.0	0	0
514	3	11.5	0.0	0.0	0.0	0	1	4	24.0	0.0	0	1
514	3	13.0	0.0	0.0	0.0	0	18	0	0.0	0.0	0	0
514	3	13.5	0.0	0.0	0.0	0	8	0	0.0	0.0	0	0
514	3	12.5	0.0	0.0	0.0	0	6	2	0.0	0.0	0	0
514	3	12.0	0.0	0.0	0.0	0	1	0	0.0	0.0	0	0
514	3	11.5	0.0	0.0	0.0	0	4	3	34.0	0.0	0	0
514	3	11.0	0.0	0.0	0.0	0	4	1	0.0	0.0	0	0
514	3	10.5	0.0	0.0	0.0	0	5	0	0.0	0.0	0	0
514	3	10.0	0.0	0.0	0.0	0	2	5	14.0	0.0	0	0
514	3	9.5	0.0	0.0	0.0	0	17	7	10.0	0.0	0	0
514	3	9.0	0.0	0.0	0.0	0	4	3	0.0	0.0	0	0
514	3	8.5	0.0	0.0	0.0	0	3	3	0.0	0.0	0	0
514	3	8.0	0.0	0.0	0.0	0	1	2	0.0	0.0	0	0
514	3	8.5	0.0	0.0	0.0	0	1	2	30.0	0.0	0	0
514	3	7.0	0.0	0.0	0.0	0	0	1	0.0	0.0	0	0
514	3	6.5	0.0	0.0	0.0	0	6	0	0.0	0.0	0	0
514	3	6.0	0.0	0.0	0.0	0	1	0	0.0	0.0	0	0
514	3	5.5	0.0	0.0	0.0	0	1	0	12.0	0.0	0	0
514	3	5.0	0.0	0.0	0.0	0	0	0	10.0	0.0	0	0
514	3	4.5	0.0	0.0	0.0	0	5	0	12.0	0.0	0	0
514	3	3.5	0.0	0.0	0.0	0	0	0	8.0	0.0	0	0
514	3	3.0	0.0	0.0	0.0	0	35	1	46.0	0.0	0	0
514	3	2.5	0.0	0.0	0.0	0	10	0	7.0	0.0	0	1
514	3	2.0	0.0	0.0	0.0	0	17	2	0.0	0.0	0	0
514	3	1.5	0.0	0.0	0.0	0	6	0	0.0	0.0	0	0
514	3	1.0	0.0	0.0	0.0	0	2	0	10.0	0.0	0	0
514	3	0.5	0.0	0.0	0.0	0	10	0	23.0	0.0	0	0
514	3	0.0	0.0	0.0	0.0	0	14	0	0.0	0.0	0	0
514	4	0.5	0.0	0.0	0.0	0	10	23	0.0	0.0	0	0
514	4	1.0	0.0	0.0	0.0	0	32	27	31.0	0.0	0	0
514	4	1.5	0.0	0.0	0.0	0	21	35	90.0	0.0	3	0
514	4	2.0	0.0	0.0	0.0	0	12	18	104.0	0.0	0	0
514	4	2.5	0.0	0.0	0.0	0	11	21	0.0	0.0	0	1
514	4	3.0	0.0	0.0	0.0	0	14	8	36.0	0.0	0	0
514	4	3.5	0.0	0.0	0.0	0	34	17	0.0	12.0	0	0
514	4	4.0	0.0	0.0	0.0	0	8	4	65.0	2.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
514	4	4.5	0.0	0.0	0.0	0	8	3	30.0	0.0	0	1
514	4	5.0	0.0	0.0	0.0	0	0	0	37.0	0.0	0	0
514	4	5.5	0.0	0.0	0.0	0	10	0	105.0	0.0	2	0
514	4	6.0	0.0	0.0	0.0	0	1	3	75.0	0.0	0	1
514	4	5.5	0.0	0.0	0.0	0	0	1	63.0	0.0	0	0
514	4	5.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
514	4	4.5	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
514	4	4.0	0.0	0.0	0.0	0	0	0	28.0	0.0	0	0
514	4	3.5	0.0	0.0	1.0	0	5	7	74.0	0.0	0	0
514	4	3.0	0.0	1.0	6.0	0	18	7	29.0	0.0	0	1
514	4	2.5	0.0	0.0	1.0	0	7	6	80.0	0.0	0	0
514	4	1.0	0.0	14.0	3.0	0	0	5	52.0	0.0	0	1
514	4	0.5	9.0	10.0	0.0	0	22	15	3.0	0.0	3	2
514	4	0.0	5.0	0.0	0.0	0	26	15	0.0	0.0	0	0
514	4	0.0	1.0	0.0	0.0	0	6	8	0.0	0.0	0	0
514	4	0.5	0.0	1.0	0.0	0	2	5	0.0	0.0	0	0
514	4	1.0	0.0	0.0	0.0	0	12	2	0.0	0.0	0	0
514	4	2.0	8.0	1.0	1.0	0	1	6	0.0	0.0	0	0
514	4	2.5	0.0	0.0	0.0	0	0	0	8.0	0.0	0	0
514	4	3.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
514	4	3.5	0.0	0.0	0.0	0	0	0	17.0	0.0	0	0
514	4	4.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
514	4	4.5	0.0	0.0	0.0	0	7	1	55.0	0.0	0	0
514	4	5.0	0.0	1.0	0.0	0	5	3	17.0	0.0	0	0
514	4	5.5	0.0	1.0	0.0	0	7	0	16.0	0.0	0	0
514	4	6.0	0.0	1.0	0.0	0	0	0	0.0	0.0	0	0
514	4	5.5	0.0	1.0	1.0	0	10	0	0.0	0.0	0	0
514	4	5.0	0.0	1.0	2.0	0	7	2	0.0	0.0	0	0
514	4	4.5	0.0	2.0	0.0	0	2	0	0.0	0.0	0	2
514	4	4.0	0.0	0.0	0.0	0	3	0	0.0	0.0	0	0
514	4	3.5	0.0	0.0	0.0	0	3	0	0.0	0.0	0	0
514	4	3.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
514	4	2.5	0.0	0.0	0.0	0	0	1	40.0	0.0	0	0
514	4	2.0	0.0	0.0	0.0	0	1	0	0.0	0.0	0	0
514	4	1.5	0.0	0.0	0.0	0	2	1	0.0	0.0	0	0
514	4	1.0	0.0	2.0	1.0	0	3	0	0.0	0.0	0	0
514	4	0.5	0.0	0.0	1.0	0	27	1	0.0	0.0	0	0
514	4	0.0	0.0	1.0	0.0	0	21	2	0.0	0.0	0	0
514	5	0.5	0.0	0.0	0.0	0	8	30	0.0	0.0	0	1
514	5	1.0	0.0	0.0	0.0	0	10	0	34.0	0.0	0	1
514	5	2.0	0.0	0.0	0.0	0	9	34	40.0	0.0	0	0
514	5	2.5	0.0	0.0	0.0	0	1	0	21.0	0.0	0	2
514	5	3.0	0.0	1.0	0.0	0	0	0	5.0	0.0	0	1
514	5	3.5	0.0	4.0	0.0	0	1	0	0.0	0.0	0	0
514	5	4.0	0.0	0.0	0.0	0	9	29	17.0	0.0	0	0
514	5	4.5	0.0	1.0	0.0	0	15	46	60.0	0.0	10	0
514	5	4.0	0.0	1.0	0.0	0	22	0	175.0	0.0	10	0
514	5	4.0	0.0	0.0	0.0	0	62	40	33.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
514	5	3.5	0.0	0.0	0.0	0	25	23	40.0	0.0	0	1
514	5	3.0	0.0	1.0	0.0	0	24	46	4.0	0.0	8	0
514	5	2.5	2.0	2.0	0.0	0	63	60	10.0	0.0	1	0
514	5	2.0	6.0	0.0	0.0	0	0	50	8.0	0.0	0	0
514	5	1.5	3.0	0.0	0.0	0	13	28	0.0	0.0	0	1
514	5	1.0	0.0	0.0	0.0	0	20	28	0.0	0.0	0	0
514	5	0.5	0.0	0.0	0.0	0	14	9	0.0	0.0	0	0
514	5	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
514	5	0.0	10.0	0.0	0.0	0	18	2	0.0	0.0	0	0
514	5	0.5	6.0	6.0	0.0	0	0	0	0.0	0.0	0	0
514	5	1.0	8.0	21.0	0.0	0	0	0	0.0	0.0	0	0
514	5	1.5	3.0	2.0	0.0	0	3	0	0.0	0.0	0	1
514	5	2.0	0.0	4.0	1.0	0	1	0	31.0	0.0	5	0
514	5	2.5	1.0	1.0	0.0	0	1	0	36.0	0.0	0	0
514	5	3.0	0.0	0.0	0.0	0	0	0	32.0	0.0	0	0
514	5	3.5	0.0	0.0	0.0	0	0	0	45.0	0.0	6	0
514	5	4.0	0.0	1.0	0.0	0	0	0	46.0	0.0	4	0
514	5	4.5	0.0	1.0	0.0	0	0	4	21.0	0.0	0	0
514	5	4.0	0.0	3.0	0.0	0	1	0	0.0	0.0	0	0
514	5	3.5	0.0	2.0	0.0	0	2	1	2.0	0.0	0	0
514	5	3.0	0.0	1.0	0.0	0	1	6	0.0	0.0	0	0
514	5	2.5	0.0	11.0	2.0	0	8	2	0.0	0.0	0	0
514	5	2.0	4.0	18.0	0.0	0	22	2	0.0	0.0	0	0
514	5	1.5	6.0	11.0	1.0	0	24	12	0.0	0.0	0	0
514	5	1.0	8.0	9.0	0.0	0	55	5	0.0	0.0	0	0
514	5	0.5	12.0	6.0	0.0	0	70	0	0.0	0.0	0	0
514	5	0.0	4.0	0.0	0.0	0	53	62	0.0	0.0	0	0
528	1	0.5	0.0	0.0	0.0	0	10	10	0.0	0.0	0	0
528	1	1.0	0.0	0.0	0.0	0	18	32	0.0	0.0	0	0
528	1	1.5	0.0	3.0	0.0	0	27	29	0.0	0.0	0	0
528	1	2.0	0.0	0.0	0.0	0	66	44	0.0	0.0	0	0
528	1	2.5	0.0	0.0	0.0	0	25	14	0.0	0.0	0	0
528	1	3.0	0.0	0.0	0.0	0	42	24	0.0	0.0	0	0
528	1	3.5	0.0	0.0	0.0	0	43	14	0.0	0.0	0	0
528	1	4.0	0.0	0.0	0.0	0	10	4	0.0	0.0	0	0
528	1	4.5	0.0	1.0	0.0	0	12	4	0.0	0.0	0	0
528	1	5.0	0.0	0.0	0.0	0	5	5	0.0	0.0	0	0
528	1	5.5	0.0	0.0	0.0	0	11	9	0.0	0.0	0	0
528	1	6.0	0.0	0.0	0.0	0	7	2	0.0	0.0	0	0
528	1	6.5	0.0	0.0	0.0	0	14	4	0.0	0.0	0	0
528	1	7.0	0.0	0.0	0.0	0	5	9	0.0	0.0	0	0
528	1	7.5	0.0	0.0	0.0	0	16	7	0.0	0.0	0	0
528	1	8.0	0.0	0.0	0.0	0	20	10	0.0	0.0	0	0
528	1	7.5	0.0	0.0	0.0	0	13	5	0.0	0.0	0	0
528	1	7.0	0.0	3.0	2.0	0	12	5	2.0	2.0	0	0
528	1	6.5	0.0	3.0	0.0	0	19	4	0.0	6.0	0	0
528	1	6.0	0.0	2.0	0.0	0	14	6	0.0	0.0	0	0
528	1	5.5	0.0	2.0	0.0	0	12	12	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
528	1	5.0	0.0	1.0	0.0	0	14	0	0.0	0.0	0	0
528	1	4.5	0.0	0.0	0.0	0	3	6	0.0	0.0	0	0
528	1	4.0	0.0	0.0	0.0	0	2	6	0.0	0.0	0	0
528	1	3.5	0.0	0.0	0.0	0	7	9	0.0	0.0	0	0
528	1	3.0	0.0	3.0	0.0	0	2	0	0.0	0.0	0	0
528	1	2.5	0.0	1.0	0.0	0	1	1	0.0	0.0	0	0
528	1	2.0	0.0	1.0	0.0	0	1	1	0.0	0.0	0	0
528	1	1.5	0.0	0.0	0.0	0	1	4	0.0	0.0	0	0
528	1	1.0	0.0	0.0	0.0	0	3	7	0.0	0.0	0	0
528	1	0.5	0.0	0.0	0.0	0	20	18	0.0	0.0	0	0
528	1	0.0	0.0	0.0	0.0	0	4	14	0.0	0.0	0	0
528	2	0.5	0.0	0.0	0.0	0	0	1	0.0	9.0	0	0
528	2	1.0	0.0	0.0	0.0	0	20	5	5.0	0.0	0	0
528	2	1.5	0.0	0.0	0.0	0	12	3	0.0	2.0	0	0
528	2	2.0	0.0	0.0	0.0	0	26	3	9.0	2.0	0	0
528	2	2.5	0.0	0.0	0.0	0	17	6	6.0	2.0	0	0
528	2	3.0	0.0	0.0	0.0	0	14	12	0.0	4.0	0	0
528	2	5.0	0.0	0.0	0.0	0	12	0	0.0	0.0	0	0
528	2	5.5	0.0	0.0	0.0	0	10	11	0.0	0.0	0	0
528	2	6.0	0.0	2.0	0.0	0	19	23	0.0	0.0	0	0
528	2	6.5	0.0	0.0	0.0	0	9	14	0.0	0.0	0	0
528	2	7.0	0.0	0.0	0.0	0	14	10	0.0	4.0	0	0
528	2	7.5	0.0	0.0	0.0	0	5	13	0.0	0.0	0	0
528	2	8.0	0.0	3.0	0.0	0	21	9	3.0	0.0	0	0
528	2	8.5	0.0	1.0	0.0	0	26	15	0.0	0.0	0	0
528	2	9.0	0.0	2.0	0.0	0	9	11	4.0	4.0	0	0
528	2	9.5	0.0	0.0	0.0	0	6	8	0.0	0.0	0	0
528	2	10.0	0.0	0.0	0.0	0	14	7	0.0	1.0	0	0
528	2	10.5	0.0	0.0	0.0	0	9	7	0.0	0.0	0	0
528	2	10.5	0.0	0.0	0.0	0	11	0	0.0	0.0	0	0
528	2	10.0	0.0	0.0	0.0	0	6	5	0.0	0.0	0	0
528	2	9.5	0.0	0.0	0.0	0	4	0	0.0	0.0	0	0
528	2	8.0	0.0	0.0	0.0	0	6	12	0.0	0.0	0	0
528	2	7.5	0.0	0.0	0.0	0	4	8	0.0	0.0	0	0
528	2	7.0	0.0	0.0	0.0	0	6	7	0.0	0.0	0	0
528	2	6.5	0.0	0.0	0.0	0	8	6	0.0	0.0	0	0
528	2	6.0	0.0	0.0	0.0	0	2	1	0.0	0.0	0	0
528	2	5.5	0.0	0.0	0.0	0	12	11	0.0	0.0	0	0
528	2	5.0	0.0	0.0	0.0	0	13	10	0.0	0.0	0	0
528	2	4.5	0.0	4.0	0.0	0	10	7	0.0	0.0	0	0
528	2	4.0	0.0	4.0	0.0	0	2	7	0.0	0.0	0	0
528	2	3.5	0.0	8.0	0.0	0	2	0	0.0	0.0	0	0
528	2	3.0	0.0	1.0	0.0	0	1	0	0.0	0.0	0	0
528	2	2.0	0.0	0.0	0.0	0	10	2	0.0	0.0	0	0
528	2	1.5	0.0	0.0	0.0	0	7	6	0.0	0.0	0	0
528	2	1.0	0.0	0.0	0.0	0	15	5	0.0	0.0	0	0
528	2	0.5	0.0	0.0	0.0	0	21	7	0.0	0.0	0	0
528	2	0.0	0.0	1.0	0.0	0	12	10	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
528	3	0.5	0.0	0.0	0.0	0	19	2	52.0	7.0	0	0
528	3	1.0	0.0	0.0	0.0	0	4	0	67.0	0.0	0	0
528	3	1.5	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
528	3	2.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
528	3	4.5	0.0	0.0	0.0	0	16	11	7.0	0.0	0	0
528	3	4.5	0.0	0.0	0.0	0	2	2	15.0	6.0	0	0
528	3	4.0	0.0	0.0	0.0	0	0	0	16.0	16.0	0	0
528	3	3.5	0.0	0.0	0.0	0	0	0	42.0	10.0	0	0
528	3	3.0	0.0	0.0	0.0	0	0	0	42.0	9.0	0	0
528	3	2.5	0.0	0.0	0.0	0	0	0	0.0	14.0	0	0
528	3	2.0	0.0	0.0	0.0	0	2	0	22.0	17.0	0	0
528	3	0.5	0.0	4.0	0.0	0	5	5	39.0	21.0	0	0
528	3	0.0	0.0	5.0	0.0	0	22	0	0.0	0.0	0	0
528	3	0.0	0.0	0.0	0.0	0	4	5	0.0	0.0	0	0
528	3	0.5	2.0	3.0	1.0	0	1	1	0.0	0.0	0	0
528	3	1.5	0.0	5.0	0.0	0	1	0	0.0	6.0	0	0
528	3	2.5	0.0	0.0	0.0	0	2	0	9.0	0.0	0	0
528	3	3.0	0.0	1.0	0.0	0	0	0	0.0	0.0	0	0
528	3	3.5	0.0	0.0	0.0	0	0	0	52.0	10.0	0	0
528	3	4.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
528	3	4.5	0.0	1.0	0.0	0	0	0	0.0	0.0	0	0
528	3	5.0	0.0	0.0	0.0	0	0	0	25.0	24.0	0	0
528	3	5.5	0.0	0.0	0.0	0	6	0	8.0	3.0	0	0
528	3	6.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
528	3	5.5	0.0	0.0	0.0	0	1	0	0.0	0.0	0	0
528	3	5.0	0.0	0.0	0.0	0	4	0	92.0	27.0	0	0
528	3	4.5	0.0	0.0	0.0	0	7	2	61.0	12.0	0	0
528	3	4.0	0.0	0.0	0.0	0	16	0	50.0	0.0	0	0
528	3	3.0	0.0	0.0	0.0	0	18	0	108.0	0.0	0	0
528	3	2.5	0.0	0.0	0.0	0	2	0	66.0	32.0	0	0
528	3	2.0	0.0	1.0	0.0	0	0	0	8.0	0.0	0	0
528	3	1.5	0.0	1.0	0.0	0	1	0	23.0	28.0	0	0
528	3	1.0	0.0	0.0	0.0	0	43	0	0.0	2.0	0	0
528	3	0.5	0.0	1.0	0.0	0	25	0	0.0	0.0	0	0
528	4	0.5	0.0	0.0	0.0	0	13	8	0.0	0.0	0	0
528	4	1.0	0.0	0.0	0.0	0	28	22	0.0	0.0	0	0
528	4	1.5	0.0	0.0	0.0	0	17	17	8.0	0.0	0	0
528	4	2.0	0.0	1.0	0.0	0	14	29	5.0	6.0	0	0
528	4	2.5	0.0	0.0	0.0	0	40	32	0.0	0.0	0	0
528	4	3.0	0.0	0.0	0.0	0	57	32	2.0	0.0	0	0
528	4	3.5	0.0	0.0	0.0	0	54	31	0.0	0.0	0	0
528	4	4.0	0.0	0.0	0.0	0	68	47	0.0	7.0	0	0
528	4	4.5	0.0	0.0	0.0	0	36	35	0.0	35.0	0	0
528	4	5.0	0.0	0.0	0.0	0	1	1	32.0	24.0	0	0
528	4	5.5	0.0	0.0	0.0	0	1	1	34.0	0.0	0	0
528	4	5.0	0.0	0.0	0.0	0	15	3	0.0	2.0	0	0
528	4	4.5	0.0	0.0	0.0	0	11	6	0.0	0.0	0	0
528	4	4.0	0.0	0.0	0.0	0	14	7	18.0	3.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
528	4	3.5	0.0	0.0	0.0	0	3	12	25.0	4.0	0	0
528	4	3.0	0.0	1.0	0.0	0	4	1	0.0	3.0	0	0
528	4	2.5	0.0	6.0	0.0	0	3	0	24.0	1.0	0	0
528	4	2.0	0.0	5.0	0.0	0	7	0	18.0	0.0	0	0
528	4	0.0	0.0	3.0	0.0	0	17	10	0.0	0.0	0	0
528	4	0.0	1.0	0.0	0.0	0	5	3	0.0	4.0	0	0
528	4	1.0	0.0	0.0	0.0	0	5	1	0.0	0.0	0	0
528	4	1.5	0.0	1.0	0.0	0	12	2	0.0	0.0	0	0
528	4	2.0	0.0	1.0	0.0	0	8	0	0.0	0.0	0	0
528	4	3.0	0.0	1.0	0.0	0	15	0	0.0	4.0	0	0
528	4	4.0	0.0	0.0	0.0	0	6	2	0.0	0.0	0	0
528	4	5.0	0.0	6.0	0.0	0	6	0	0.0	1.0	0	0
528	4	4.5	0.0	0.0	0.0	0	0	0	0.0	3.0	0	0
528	4	4.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
528	4	3.5	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
528	4	3.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
528	4	2.5	0.0	0.0	0.0	0	0	0	0.0	2.0	0	0
528	4	2.0	0.0	5.0	0.0	0	0	0	0.0	0.0	0	0
528	4	1.5	0.0	7.0	0.0	0	9	3	0.0	0.0	0	0
528	4	1.0	0.0	3.0	0.0	0	10	3	0.0	0.0	0	0
528	4	0.5	0.0	1.0	0.0	0	13	8	0.0	0.0	0	0
528	4	0.0	0.0	0.0	0.0	0	13	18	12.0	0.0	0	0
528	5	0.5	0.0	0.0	0.0	0	2	4	0.0	0.0	0	0
528	5	1.5	0.0	0.0	0.0	0	12	24	28.0	0.0	0	0
528	5	2.0	0.0	0.0	0.0	0	8	11	41.0	41.0	0	0
528	5	2.5	0.0	0.0	3.0	0	28	20	44.0	0.0	0	0
528	5	3.0	0.0	0.0	0.0	0	30	14	34.0	35.0	0	0
528	5	3.5	0.0	1.0	0.0	0	11	19	13.0	12.0	0	0
528	5	4.0	0.0	1.0	0.0	0	28	40	3.0	3.0	0	0
528	5	4.5	0.0	0.0	0.0	0	38	60	12.0	0.0	4	0
528	5	5.0	0.0	1.0	0.0	0	22	46	5.0	5.0	0	0
528	5	5.5	0.0	0.0	0.0	0	32	54	0.0	0.0	0	0
528	5	6.0	0.0	2.0	0.0	0	20	11	3.0	0.0	0	0
528	5	6.0	0.0	1.0	0.0	0	8	9	0.0	7.0	0	0
528	5	4.0	0.0	5.0	0.0	0	25	41	0.0	5.0	0	0
528	5	3.5	0.0	9.0	0.0	0	4	12	0.0	0.0	0	0
528	5	3.0	0.0	12.0	0.0	0	20	14	2.0	2.0	0	2
528	5	2.5	0.0	9.0	0.0	0	12	6	1.0	3.0	0	1
528	5	2.0	0.0	2.0	0.0	0	5	12	11.0	12.0	0	0
528	5	1.5	0.0	5.0	0.0	0	0	1	14.0	4.0	0	0
528	5	1.0	0.0	1.0	0.0	0	0	0	11.0	11.0	0	0
528	5	0.5	0.0	0.0	0.0	0	1	1	6.0	6.0	0	0
528	5	0.0	0.0	0.0	0.0	0	2	2	0.0	0.0	0	0
528	5	0.5	0.0	2.0	0.0	0	9	7	0.0	0.0	0	0
528	5	1.0	0.0	3.0	0.0	0	8	0	0.0	0.0	5	0
528	5	1.5	0.0	0.0	0.0	0	7	0	2.0	0.0	2	0
528	5	2.0	0.0	1.0	0.0	0	9	0	0.0	0.0	0	0
528	5	2.5	0.0	2.0	0.0	0	11	9	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
528	5	3.0	0.0	0.0	0.0	0	0	5	0.0	0.0	0	0
528	5	3.5	0.0	1.0	0.0	0	4	2	0.0	0.0	0	0
528	5	4.0	0.0	0.0	0.0	0	5	9	9.0	0.0	2	0
528	5	4.5	0.0	3.0	0.0	0	8	3	0.0	0.0	0	0
528	5	4.5	0.0	1.0	0.0	0	13	4	0.0	8.0	10	0
528	5	4.0	0.0	0.0	0.0	0	6	4	0.0	0.0	0	0
528	5	3.5	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
528	5	3.0	0.0	4.0	0.0	0	9	0	0.0	0.0	2	0
528	5	2.5	0.0	21.0	0.0	0	7	1	0.0	1.0	0	0
528	5	2.0	0.0	14.0	0.0	0	5	3	0.0	1.0	0	0
528	5	1.0	0.0	11.0	0.0	0	22	12	0.0	0.0	0	0
528	5	0.5	2.0	6.0	0.0	0	15	3	0.0	0.0	0	0
528	5	0.0	0.0	0.0	0.0	0	23	3	0.0	0.0	0	0
616	1	0.5	0.0	0.0	0.0	0	26	12	0.0	0.0	0	0
616	1	1.0	0.0	0.0	0.0	0	12	11	14.0	0.0	0	0
616	1	1.5	0.0	0.0	0.0	0	10	17	0.0	0.0	0	0
616	1	2.0	0.0	0.0	0.0	0	7	13	0.0	0.0	0	0
616	1	2.5	0.0	0.0	0.0	0	24	18	0.0	0.0	0	0
616	1	3.0	0.0	0.0	0.0	0	40	11	0.0	0.0	0	0
616	1	3.5	0.0	0.0	0.0	0	3	19	0.0	0.0	0	0
616	1	4.0	0.0	0.0	0.0	0	20	16	0.0	0.0	0	0
616	1	5.5	0.0	0.0	0.0	0	1	6	0.0	0.0	0	0
616	1	7.5	0.0	0.0	0.0	0	5	5	0.0	0.0	0	0
616	1	7.0	0.0	0.0	1.0	0	5	8	0.0	0.0	0	0
616	1	6.5	0.0	0.0	4.0	0	14	4	0.0	0.0	0	0
616	1	6.0	0.0	0.0	0.0	0	6	10	0.0	0.0	0	0
616	1	4.5	0.0	0.0	0.0	0	6	0	0.0	0.0	0	0
616	1	4.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
616	1	3.5	0.0	0.0	0.0	0	1	1	0.0	0.0	0	0
616	1	3.0	0.0	0.0	1.0	0	1	0	0.0	0.0	0	0
616	1	2.5	0.0	0.0	0.0	0	2	0	0.0	0.0	0	0
616	1	1.5	0.0	0.0	0.0	0	45	9	0.0	0.0	0	0
616	1	1.0	0.0	0.0	0.0	0	16	0	0.0	0.0	0	0
616	1	0.5	0.0	0.0	0.0	0	33	2	0.0	0.0	0	0
616	1	0.0	0.0	0.0	0.0	0	5	9	0.0	0.0	0	0
616	2	0.5	0.0	0.0	0.0	0	3	5	0.0	0.0	0	0
616	2	1.0	0.0	0.0	0.0	0	8	3	0.0	0.0	0	0
616	2	1.5	0.0	0.0	0.0	0	16	6	0.0	0.0	0	0
616	2	2.0	0.0	0.0	0.0	0	22	1	0.0	0.0	0	0
616	2	2.5	0.0	0.0	0.0	0	4	6	0.0	0.0	0	0
616	2	3.0	0.0	0.0	0.0	0	17	5	3.0	0.0	0	0
616	2	3.5	0.0	0.0	0.0	0	32	0	6.0	0.0	0	0
616	2	4.0	0.0	0.0	0.0	0	15	6	0.0	0.0	0	0
616	2	4.5	0.0	0.0	0.0	0	27	6	0.0	0.0	0	0
616	2	5.0	0.0	0.0	0.0	0	33	3	0.0	0.0	0	0
616	2	5.5	0.0	0.0	0.0	0	26	8	0.0	0.0	0	0
616	2	6.0	0.0	0.0	1.0	0	15	12	10.0	0.0	0	0
616	2	5.5	0.0	0.0	0.0	0	13	6	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
616	2	5.0	0.0	0.0	0.0	0	34	18	11.0	12.0	0	0
616	2	4.5	0.0	0.0	0.0	0	24	17	8.0	0.0	0	0
616	2	4.0	0.0	0.0	0.0	0	36	22	0.0	0.0	0	0
616	2	3.5	0.0	0.0	0.0	0	22	18	4.0	1.0	0	0
616	2	3.0	0.0	0.0	0.0	0	53	14	7.0	0.0	0	0
616	2	2.5	0.0	0.0	1.0	0	24	24	0.0	0.0	0	0
616	2	2.0	0.0	0.0	0.0	0	41	25	0.0	4.0	0	0
616	2	1.5	0.0	0.0	0.0	0	3	1	0.0	0.0	0	0
616	2	1.0	0.0	0.0	0.0	0	26	11	2.0	4.0	0	0
616	2	0.5	0.0	0.0	0.0	0	9	9	0.0	9.0	0	0
616	2	0.0	0.0	0.0	0.0	0	10	7	21.0	11.0	0	0
616	2	0.0	0.0	0.0	0.0	0	15	15	0.0	2.0	0	0
616	2	0.5	0.0	0.0	0.0	0	15	23	0.0	0.0	0	0
616	2	1.0	0.0	0.0	0.0	0	24	16	0.0	0.0	0	0
616	2	1.5	0.0	0.0	0.0	0	28	16	0.0	0.0	0	0
616	2	2.0	0.0	0.0	0.0	0	13	13	0.0	0.0	0	0
616	2	2.5	0.0	0.0	0.0	0	9	6	0.0	0.0	0	0
616	2	3.0	0.0	0.0	0.0	0	3	10	0.0	0.0	0	0
616	2	3.0	0.0	0.0	0.0	0	12	7	0.0	0.0	0	0
616	2	2.5	0.0	0.0	0.0	0	11	3	0.0	0.0	0	0
616	2	2.0	0.0	0.0	0.0	0	14	17	0.0	0.0	0	0
616	2	1.5	0.0	0.0	0.0	0	7	2	0.0	0.0	0	0
616	2	1.0	0.0	0.0	0.0	0	12	7	0.0	0.0	0	0
616	2	0.5	0.0	0.0	0.0	0	11	4	0.0	0.0	0	0
616	2	0.0	0.0	0.0	0.0	0	21	0	0.0	0.0	0	0
616	3	0.5	0.0	0.0	0.0	0	6	13	0.0	0.0	0	0
616	3	1.0	0.0	0.0	0.0	0	13	16	6.0	1.0	0	0
616	3	1.5	0.0	0.0	0.0	0	21	13	0.0	3.0	0	0
616	3	2.0	0.0	0.0	0.0	0	24	16	16.0	0.0	0	0
616	3	2.5	0.0	0.0	0.0	0	13	34	2.0	5.0	0	0
616	3	3.0	0.0	0.0	0.0	0	31	6	0.0	0.0	0	0
616	3	3.5	0.0	0.0	0.0	0	17	32	22.0	0.0	0	0
616	3	4.0	0.0	0.0	0.0	0	9	14	0.0	0.0	0	0
616	3	4.5	0.0	0.0	0.0	0	25	7	0.0	1.0	0	0
616	3	4.0	0.0	0.0	0.0	0	30	12	0.0	0.0	0	0
616	3	3.5	0.0	0.0	0.0	0	29	15	0.0	0.0	0	0
616	3	3.0	0.0	0.0	1.0	0	17	15	0.0	0.0	0	0
616	3	2.5	0.0	0.0	0.0	0	23	3	1.0	4.0	0	0
616	3	2.0	0.0	0.0	0.0	0	55	4	0.0	0.0	0	0
616	3	1.5	0.0	0.0	0.0	0	34	6	0.0	2.0	0	0
616	3	1.0	0.0	0.0	0.0	0	30	40	2.0	0.0	0	0
616	3	0.5	0.0	0.0	0.0	0	51	18	0.0	0.0	0	0
616	3	0.5	0.0	0.0	0.0	0	7	42	0.0	1.0	0	0
616	3	1.5	0.0	0.0	0.0	0	2	44	0.0	1.0	0	0
616	3	2.0	0.0	0.0	0.0	0	15	2	0.0	2.0	0	0
616	3	2.5	0.0	0.0	0.0	0	6	2	29.0	0.0	0	0
616	3	3.0	0.0	0.0	0.0	0	5	0	8.0	12.0	0	0
616	3	4.0	0.0	0.0	0.0	0	10	5	21.0	5.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
616	3	3.5	0.0	0.0	0.0	0	4	0	105.0	48.0	0	0
616	3	3.0	0.0	0.0	1.0	0	0	0	39.0	35.0	0	0
616	3	2.5	0.0	0.0	0.0	0	0	0	24.0	15.0	0	0
616	3	2.0	0.0	0.0	0.0	0	0	0	60.0	12.0	0	0
616	3	1.5	0.0	0.0	0.0	0	22	11	30.0	8.0	0	0
616	3	1.0	0.0	0.0	0.0	0	34	13	0.0	0.0	0	0
616	3	0.5	0.0	0.0	0.0	0	33	13	4.0	1.0	0	0
616	3	0.0	0.0	1.0	0.0	0	1	0	8.0	1.0	0	0
616	4	0.5	0.0	0.0	0.0	0	16	66	0.0	0.0	0	0
616	4	1.0	0.0	0.0	0.0	0	31	79	0.0	0.0	0	0
616	4	1.5	0.0	0.0	0.0	0	42	90	0.0	0.0	0	0
616	4	2.0	0.0	0.0	0.0	0	40	97	0.0	0.0	0	0
616	4	2.5	0.0	0.0	0.0	0	19	0	0.0	0.0	0	0
616	4	3.0	0.0	0.0	0.0	0	52	87	6.0	0.0	0	0
616	4	3.5	0.0	0.0	0.0	0	30	70	34.0	6.0	0	0
616	4	4.0	0.0	0.0	0.0	0	35	58	0.0	12.0	0	0
616	4	3.5	0.0	0.0	0.0	0	17	46	0.0	0.0	0	0
616	4	3.0	0.0	0.0	0.0	0	29	50	0.0	0.0	0	0
616	4	2.5	0.0	0.0	1.0	0	39	59	1.0	5.0	0	0
616	4	2.0	0.0	0.0	1.0	0	51	87	0.0	0.0	0	0
616	4	1.5	0.0	0.0	2.0	0	38	57	2.0	2.0	0	0
616	4	1.0	0.0	0.0	0.0	0	37	70	11.0	0.0	15	0
616	4	0.5	0.0	0.0	1.0	0	45	54	2.0	2.0	0	0
616	4	0.0	0.0	0.0	0.0	0	16	0	0.0	0.0	0	0
616	4	0.5	0.0	0.0	0.0	0	6	15	0.0	0.0	0	0
616	4	1.0	0.0	0.0	3.0	0	19	10	0.0	0.0	0	0
616	4	1.5	0.0	0.0	0.0	0	12	15	0.0	0.0	0	0
616	4	2.0	0.0	0.0	0.0	0	4	13	0.0	0.0	0	0
616	4	2.5	0.0	0.0	2.0	0	5	0	1.0	3.0	0	0
616	4	3.0	0.0	0.0	0.0	0	26	2	0.0	0.0	0	0
616	4	3.5	0.0	0.0	0.0	0	12	8	0.0	0.0	0	0
616	4	4.0	0.0	0.0	2.0	0	4	0	23.0	11.0	0	0
616	4	4.5	0.0	0.0	1.0	0	1	0	0.0	10.0	0	0
616	4	4.5	0.0	0.0	2.0	0	1	1	0.0	1.0	0	0
616	4	3.5	0.0	0.0	6.0	0	0	0	0.0	2.0	0	0
616	4	3.0	0.0	0.0	12.0	0	0	0	0.0	0.0	0	0
616	4	2.5	0.0	0.0	8.0	0	2	0	0.0	0.0	0	0
616	4	2.0	0.0	0.0	0.0	0	12	0	0.0	0.0	0	0
616	4	1.5	0.0	0.0	2.0	0	45	25	0.0	0.0	0	0
616	4	1.0	0.0	0.0	1.0	0	33	8	48.0	7.0	0	0
616	4	0.5	0.0	0.0	0.0	0	26	22	0.0	0.0	0	0
616	4	0.0	0.0	0.0	1.0	0	6	9	0.0	0.0	0	0
616	5	0.5	0.0	0.0	0.0	0	6	33	0.0	0.0	0	0
616	5	1.0	0.0	0.0	0.0	0	0	13	0.0	0.0	0	0
616	5	1.5	0.0	0.0	0.0	0	18	14	0.0	0.0	0	0
616	5	2.0	0.0	0.0	0.0	0	12	9	0.0	0.0	0	0
616	5	2.5	0.0	0.0	0.0	0	9	9	0.0	0.0	0	0
616	5	3.0	0.0	0.0	0.0	0	14	8	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
616	5	3.5	0.0	0.0	0.0	0	24	15	0.0	0.0	0	0
616	5	3.0	0.0	0.0	0.0	0	15	24	0.0	0.0	0	0
616	5	2.5	0.0	0.0	0.0	0	10	70	0.0	0.0	0	0
616	5	2.0	0.0	0.0	0.0	0	30	88	0.0	0.0	0	0
616	5	1.5	0.0	0.0	1.0	0	30	80	0.0	0.0	0	0
616	5	1.0	0.0	0.0	0.0	0	40	110	0.0	0.0	0	0
616	5	0.5	0.0	0.0	0.0	0	28	88	0.0	0.0	0	0
616	5	0.0	0.0	0.0	0.0	0	6	31	0.0	0.0	0	0
616	5	0.5	0.0	0.0	0.0	0	6	18	0.0	0.0	0	0
616	5	1.0	0.0	0.0	0.0	0	9	25	0.0	0.0	0	0
616	5	1.5	0.0	0.0	1.0	0	23	20	1.0	0.0	0	0
616	5	2.5	0.0	0.0	0.0	0	40	8	4.0	0.0	0	0
616	5	3.0	0.0	0.0	0.0	0	13	18	0.0	0.0	0	0
616	5	3.5	0.0	0.0	0.0	0	8	12	0.0	0.0	0	0
616	5	4.0	0.0	0.0	0.0	0	2	6	0.0	0.0	0	0
616	5	4.5	0.0	0.0	0.0	0	45	12	25.0	0.0	5	0
616	5	5.0	0.0	0.0	0.0	0	0	1	0.0	0.0	0	0
616	5	4.5	0.0	0.0	0.0	0	26	12	0.0	0.0	0	0
616	5	4.0	0.0	0.0	0.0	0	13	15	0.0	0.0	0	0
616	5	3.5	0.0	0.0	0.0	0	7	15	0.0	0.0	0	0
616	5	3.0	0.0	0.0	1.0	0	2	9	0.0	0.0	0	0
616	5	2.5	0.0	0.0	0.0	0	8	9	0.0	0.0	0	0
616	5	2.0	0.0	0.0	0.0	0	11	13	0.0	0.0	0	0
616	5	1.5	0.0	0.0	0.0	0	15	16	0.0	0.0	0	0
616	5	1.0	0.0	0.0	0.0	0	15	31	0.0	0.0	0	0
616	5	0.5	0.0	0.0	0.0	0	6	29	0.0	0.0	0	0
616	5	0.0	0.0	0.0	0.0	0	3	23	0.0	0.0	0	0
630	1	0.5	0.0	0.0	0.0	0	13	2	4.0	0.0	0	0
630	1	1.0	0.0	0.0	0.0	0	14	5	10.0	0.0	0	0
630	1	1.5	0.0	0.0	0.0	0	11	6	0.0	0.0	0	0
630	1	2.0	0.0	0.0	0.0	0	2	10	4.0	2.0	0	0
630	1	2.5	0.0	0.0	0.0	0	7	8	4.0	0.0	0	0
630	1	3.5	0.0	0.0	0.0	0	21	7	0.0	0.0	0	0
630	1	4.0	0.0	0.0	0.0	0	7	10	0.0	0.0	0	0
630	1	4.5	0.0	0.0	0.0	0	0	20	0.0	0.0	0	0
630	1	5.0	0.0	0.0	0.0	0	6	12	0.0	0.0	0	0
630	1	5.5	0.0	0.0	0.0	0	28	15	1.0	0.0	0	0
630	1	6.0	0.0	0.0	0.0	0	25	7	0.0	0.0	0	0
630	1	6.5	0.0	0.0	0.0	0	12	12	0.0	0.0	0	0
630	1	7.0	0.0	0.0	0.0	0	11	42	0.0	0.0	0	0
630	1	7.5	0.0	0.0	0.0	0	6	30	0.0	0.0	0	0
630	1	9.0	0.0	0.0	0.0	0	3	17	0.0	0.0	0	0
630	1	9.0	0.0	0.0	0.0	1	1	21	0.0	0.0	0	0
630	1	8.5	0.0	0.0	0.0	0	1	7	0.0	0.0	0	0
630	1	8.0	0.0	0.0	0.0	0	3	9	0.0	0.0	0	0
630	1	7.5	0.0	0.0	0.0	0	15	26	0.0	0.0	0	0
630	1	7.0	0.0	0.0	0.0	0	10	16	0.0	0.0	0	0
630	1	6.5	0.0	0.0	0.0	0	14	15	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
630	1	6.0	0.0	0.0	0.0	0	22	26	0.0	0.0	0	0
630	1	5.5	0.0	0.0	0.0	0	25	10	0.0	0.0	0	0
630	1	5.0	0.0	0.0	0.0	0	4	4	0.0	0.0	0	0
630	1	4.5	0.0	0.0	0.0	0	10	13	0.0	0.0	0	0
630	1	4.0	0.0	0.0	0.0	1	20	14	0.0	0.0	0	0
630	1	3.5	0.0	0.0	0.0	0	28	10	0.0	1.0	0	0
630	1	3.0	0.0	0.0	0.0	0	65	14	0.0	1.0	0	0
630	1	2.5	0.0	0.0	0.0	0	72	11	0.0	0.0	0	0
630	1	2.0	0.0	0.0	0.0	0	7	4	0.0	0.0	0	0
630	1	1.5	0.0	0.0	0.0	0	9	0	0.0	1.0	0	0
630	1	1.0	0.0	0.0	0.0	0	5	7	0.0	0.0	0	0
630	1	0.5	0.0	0.0	0.0	0	2	7	0.0	0.0	0	0
630	1	0.0	0.0	0.0	0.0	0	2	15	0.0	0.0	0	0
630	2	0.5	0.0	0.0	0.0	0	4	2	0.0	0.0	0	0
630	2	1.0	0.0	0.0	0.0	0	28	3	0.0	0.0	0	0
630	2	1.5	0.0	0.0	0.0	0	14	7	0.0	1.0	0	0
630	2	2.0	0.0	0.0	0.0	0	23	14	0.0	0.0	0	0
630	2	1.5	0.0	0.0	0.0	0	4	10	0.0	0.0	0	0
630	2	1.0	0.0	0.0	0.0	0	1	11	0.0	0.0	0	0
630	2	0.0	0.0	0.0	0.0	0	3	7	0.0	0.0	0	0
630	2	0.5	0.0	0.0	0.0	0	6	1	0.0	1.0	0	0
630	2	1.0	0.0	0.0	0.0	0	1	15	7.0	1.0	0	0
630	2	1.5	0.0	0.0	0.0	0	20	42	12.0	3.0	0	0
630	2	2.0	0.0	0.0	0.0	3	38	36	0.0	2.0	0	0
630	2	2.5	0.0	0.0	0.0	1	30	50	0.0	5.0	0	0
630	2	3.0	0.0	0.0	0.0	0	41	50	0.0	0.0	0	0
630	2	3.5	0.0	0.0	0.0	0	28	33	0.0	4.0	0	0
630	2	4.0	0.0	0.0	0.0	1	15	39	0.0	0.0	0	0
630	2	4.5	0.0	0.0	0.0	1	13	22	4.0	0.0	0	0
630	2	5.0	0.0	0.0	0.0	1	9	28	0.0	0.0	0	0
630	2	6.0	0.0	0.0	0.0	0	13	22	0.0	0.0	0	0
630	2	7.0	0.0	0.0	0.0	0	2	7	0.0	0.0	0	0
630	2	7.5	0.0	0.0	0.0	0	11	10	0.0	0.0	0	0
630	2	6.5	0.0	0.0	0.0	0	16	16	0.0	0.0	0	0
630	2	6.0	0.0	0.0	0.0	0	20	0	0.0	0.0	0	0
630	2	5.5	0.0	0.0	0.0	0	13	8	0.0	0.0	0	0
630	2	5.0	0.0	0.0	0.0	0	2	0	0.0	0.0	0	0
630	2	4.5	0.0	0.0	0.0	0	7	13	0.0	0.0	0	0
630	2	4.0	0.0	0.0	0.0	0	9	10	0.0	0.0	0	0
630	2	3.5	0.0	0.0	0.0	0	9	0	0.0	0.0	0	0
630	2	3.0	0.0	0.0	0.0	0	5	1	0.0	0.0	0	0
630	2	2.5	0.0	0.0	0.0	0	6	5	0.0	0.0	0	0
630	2	2.0	0.0	0.0	0.0	0	5	6	0.0	0.0	0	0
630	2	1.5	0.0	0.0	0.0	0	9	4	0.0	0.0	0	0
630	2	1.0	0.0	0.0	0.0	0	7	6	0.0	0.0	0	0
630	2	0.5	0.0	0.0	0.0	0	1	7	0.0	0.0	0	0
630	2	0.0	0.0	0.0	0.0	0	3	11	0.0	0.0	0	0
630	3	0.5	0.0	0.0	0.0	0	6	14	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
630	3	1.0	0.0	0.0	0.0	0	14	13	9.0	0.0	0	0
630	3	1.5	0.0	0.0	0.0	0	4	7	16.0	1.0	0	0
630	3	2.0	0.0	0.0	0.0	0	4	0	0.0	3.0	0	0
630	3	3.0	0.0	0.0	0.0	0	0	3	0.0	4.0	0	0
630	3	4.0	0.0	0.0	0.0	0	2	7	0.0	0.0	0	0
630	3	4.5	0.0	0.0	0.0	0	2	22	0.0	0.0	0	0
630	3	3.0	0.0	0.0	0.0	0	22	16	0.0	1.0	0	0
630	3	2.5	0.0	0.0	0.0	0	11	6	8.0	8.0	0	0
630	3	2.0	0.0	0.0	0.0	0	19	11	18.0	14.0	0	0
630	3	1.5	0.0	0.0	1.0	0	12	7	8.0	34.0	0	0
630	3	1.0	0.0	0.0	0.0	0	5	15	0.0	8.0	0	0
630	3	0.5	0.0	0.0	0.0	0	8	65	0.0	9.0	0	0
630	3	0.0	0.0	0.0	0.0	0	0	20	0.0	13.0	0	0
630	3	0.5	0.0	0.0	0.0	0	4	16	0.0	0.0	0	0
630	3	1.0	0.0	0.0	0.0	0	2	13	5.0	0.0	0	0
630	3	1.5	0.0	0.0	0.0	0	0	1	0.0	0.0	0	0
630	3	2.0	0.0	0.0	0.0	0	1	3	0.0	0.0	0	0
630	3	3.5	0.0	0.0	0.0	0	0	1	0.0	0.0	0	0
630	3	4.0	0.0	0.0	0.0	0	2	0	1.0	0.0	0	0
630	3	4.5	0.0	0.0	0.0	0	0	0	3.0	0.0	0	0
630	3	4.0	0.0	0.0	0.0	0	0	0	10.0	12.0	0	0
630	3	3.5	0.0	0.0	0.0	1	0	0	12.0	13.0	0	0
630	3	3.0	0.0	0.0	0.0	0	2	3	20.0	19.0	0	0
630	3	2.5	0.0	0.0	0.0	0	0	0	16.0	22.0	0	0
630	3	2.0	0.0	0.0	0.0	0	2	0	15.0	16.0	0	0
630	3	1.0	0.0	0.0	0.0	0	0	0	0.0	2.0	0	0
630	3	0.5	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
630	3	0.0	0.0	0.0	0.0	0	2	3	0.0	0.0	0	0
630	4	0.5	0.0	0.0	0.0	0	0	12	0.0	0.0	0	0
630	4	1.0	0.0	0.0	0.0	0	6	14	0.0	0.0	0	0
630	4	1.5	0.0	0.0	0.0	0	0	8	0.0	0.0	0	0
630	4	2.0	0.0	0.0	0.0	0	7	12	0.0	1.0	0	0
630	4	2.5	0.0	0.0	0.0	0	8	27	0.0	2.0	0	0
630	4	3.0	0.0	0.0	0.0	0	3	19	30.0	0.0	0	0
630	4	3.5	0.0	0.0	0.0	0	7	12	25.0	5.0	0	0
630	4	4.0	0.0	0.0	0.0	0	5	4	2.0	1.0	0	0
630	4	4.5	0.0	0.0	0.0	0	24	20	33.0	2.0	0	0
630	4	4.5	0.0	0.0	0.0	0	0	7	0.0	1.0	0	0
630	4	4.0	0.0	0.0	0.0	0	2	30	0.0	0.0	0	0
630	4	3.5	0.0	0.0	0.0	0	4	26	0.0	3.0	0	0
630	4	3.0	0.0	0.0	0.0	0	6	33	0.0	0.0	0	0
630	4	2.5	0.0	0.0	0.0	0	7	34	0.0	0.0	0	0
630	4	2.0	0.0	0.0	0.0	0	2	27	0.0	1.0	0	0
630	4	1.5	0.0	0.0	0.0	0	12	26	12.0	15.0	0	0
630	4	1.0	0.0	0.0	1.0	0	0	29	3.0	16.0	0	0
630	4	0.5	0.0	0.0	0.0	0	10	63	0.0	2.0	0	0
630	4	0.0	0.0	0.0	0.0	0	2	59	0.0	5.0	0	0
630	4	0.5	0.0	0.0	0.0	0	2	37	0.0	2.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
630	4	1.0	0.0	0.0	0.0	0	3	26	0.0	2.0	0	0
630	4	1.5	0.0	0.0	0.0	0	0	0	0.0	5.0	0	0
630	4	2.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
630	4	2.5	0.0	0.0	0.0	0	2	2	0.0	0.0	0	0
630	4	3.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
630	4	3.5	0.0	0.0	0.0	0	2	0	0.0	0.0	0	0
630	4	3.5	0.0	0.0	0.0	0	2	0	0.0	0.0	0	0
630	4	3.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
630	4	2.5	0.0	0.0	0.0	0	0	1	0.0	4.0	0	0
630	4	2.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
630	4	1.5	0.0	0.0	0.0	0	1	0	0.0	0.0	0	0
630	4	1.0	0.0	0.0	0.0	0	0	0	0.0	1.0	0	0
630	4	0.5	0.0	0.0	0.0	0	1	0	0.0	1.0	0	0
630	4	0.0	0.0	0.0	0.0	0	4	13	0.0	0.0	0	0
630	5	0.5	0.0	0.0	0.0	0	2	0	0.0	0.0	0	0
630	5	1.0	0.0	0.0	0.0	0	6	17	0.0	0.0	0	0
630	5	1.5	0.0	0.0	0.0	0	3	22	0.0	2.0	0	0
630	5	2.0	0.0	0.0	0.0	0	7	24	0.0	0.0	0	0
630	5	2.5	0.0	0.0	0.0	0	7	24	0.0	0.0	0	0
630	5	3.0	0.0	0.0	0.0	0	12	29	0.0	0.0	0	0
630	5	3.5	0.0	0.0	0.0	0	4	26	0.0	0.0	0	0
630	5	4.0	0.0	0.0	0.0	0	40	45	0.0	0.0	0	0
630	5	4.0	0.0	0.0	0.0	0	0	91	0.0	1.0	0	0
630	5	3.5	0.0	0.0	0.0	0	7	83	0.0	0.0	0	0
630	5	3.0	0.0	0.0	0.0	0	14	78	0.0	0.0	0	0
630	5	2.5	0.0	0.0	0.0	0	9	74	10.0	13.0	0	0
630	5	2.0	0.0	0.0	0.0	0	5	116	0.0	1.0	0	0
630	5	1.5	0.0	0.0	0.0	0	9	140	0.0	0.0	0	0
630	5	0.0	0.0	0.0	0.0	0	3	89	0.0	0.0	0	0
630	5	0.5	0.0	0.0	0.0	0	0	57	0.0	0.0	0	0
630	5	1.0	0.0	0.0	0.0	0	2	69	0.0	0.0	0	0
630	5	1.5	0.0	0.0	0.0	0	7	47	0.0	0.0	0	0
630	5	2.5	0.0	0.0	0.0	0	8	43	0.0	0.0	0	0
630	5	3.0	0.0	0.0	0.0	0	15	14	0.0	0.0	0	0
630	5	3.5	0.0	0.0	0.0	1	7	11	0.0	0.0	0	0
630	5	4.0	0.0	0.0	0.0	0	7	18	0.0	0.0	0	0
630	5	4.5	0.0	0.0	0.0	0	3	11	0.0	2.0	0	0
630	5	5.0	0.0	0.0	0.0	0	10	6	0.0	12.0	0	0
630	5	4.5	0.0	0.0	1.0	0	0	0	0.0	0.0	0	0
630	5	4.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
630	5	3.5	0.0	0.0	1.0	0	0	0	0.0	2.0	0	0
630	5	3.0	0.0	0.0	2.0	0	0	0	0.0	0.0	0	0
630	5	2.5	0.0	0.0	2.0	0	0	0	0.0	0.0	0	0
630	5	2.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
630	5	1.5	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
630	5	1.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
630	5	0.5	0.0	0.0	0.0	0	0	0	0.0	0.0	0	0
630	5	0.0	0.0	0.0	0.0	0	6	7	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
717	1	0.5	0.0	0.0	0.0	4	17	32	0.0	0.0	0	0
717	1	1.0	0.0	0.0	0.0	0	21	32	0.0	0.0	0	0
717	1	2.0	0.0	0.0	0.0	0	6	9	0.0	0.0	0	0
717	1	2.5	0.0	0.0	0.0	0	13	10	0.0	0.0	0	0
717	1	3.0	0.0	0.0	0.0	0	14	7	0.0	0.0	0	0
717	1	3.5	0.0	0.0	0.0	0	6	6	0.0	0.0	0	0
717	1	3.0	0.0	0.0	0.0	0	2	3	0.0	0.0	0	0
717	1	2.5	0.0	0.0	0.0	0	1	3	0.0	0.0	0	0
717	1	2.0	0.0	0.0	0.0	0	1	3	0.0	0.0	0	0
717	1	1.5	0.0	0.0	0.0	0	26	1	0.0	0.0	0	0
717	1	1.0	0.0	0.0	0.0	0	13	9	0.0	0.0	0	0
717	1	0.5	0.0	0.0	0.0	0	8	3	0.0	0.0	0	0
717	1	0.0	0.0	0.0	0.0	0	0	2	0.0	0.0	0	0
717	2	0.5	0.0	0.0	0.0	0	1	0	0.0	0.0	0	0
717	2	1.0	0.0	0.0	0.0	0	11	40	0.0	0.0	0	0
717	2	1.5	0.0	0.0	0.0	0	20	22	0.0	0.0	0	0
717	2	2.0	0.0	0.0	0.0	1	13	13	0.0	0.0	0	0
717	2	2.5	0.0	0.0	0.0	0	32	2	0.0	0.0	0	0
717	2	3.0	0.0	0.0	0.0	0	43	5	0.0	0.0	0	0
717	2	3.5	0.0	0.0	0.0	0	10	11	0.0	0.0	0	0
717	2	4.0	0.0	0.0	0.0	0	5	4	0.0	0.0	0	0
717	2	4.0	0.0	0.0	0.0	0	4	3	0.0	0.0	0	0
717	2	3.5	0.0	0.0	0.0	0	9	3	0.0	0.0	0	0
717	2	3.0	0.0	0.0	0.0	0	6	5	0.0	0.0	0	0
717	2	2.5	0.0	0.0	0.0	0	20	5	0.0	0.0	0	0
717	2	2.0	0.0	0.0	0.0	0	46	5	0.0	3.0	0	0
717	2	1.5	0.0	0.0	0.0	0	10	10	0.0	0.0	0	0
717	2	1.0	0.0	0.0	0.0	0	10	0	0.0	0.0	0	0
717	2	0.5	0.0	0.0	0.0	0	0	4	0.0	0.0	0	0
717	2	0.0	0.0	0.0	0.0	0	1	2	0.0	0.0	0	0
717	3	0.5	0.0	0.0	0.0	0	15	13	0.0	0.0	0	0
717	3	1.0	0.0	0.0	0.0	0	40	32	0.0	0.0	0	0
717	3	1.5	0.0	0.0	0.0	0	18	27	2.0	0.0	0	0
717	3	2.5	0.0	0.0	0.0	0	5	18	0.0	0.0	0	0
717	3	3.5	0.0	0.0	0.0	0	8	10	0.0	1.0	0	0
717	3	4.0	0.0	0.0	0.0	0	11	7	0.0	0.0	0	0
717	3	4.5	0.0	0.0	0.0	0	5	4	0.0	0.0	0	0
717	3	5.0	0.0	0.0	0.0	0	7	4	0.0	1.0	0	0
717	3	5.5	0.0	0.0	0.0	0	13	12	0.0	1.0	0	0
717	3	6.0	0.0	0.0	0.0	0	11	37	0.0	0.0	0	0
717	3	5.5	0.0	0.0	0.0	0	4	7	0.0	0.0	0	0
717	3	5.0	0.0	0.0	0.0	0	12	15	0.0	0.0	0	0
717	3	4.5	0.0	0.0	0.0	0	0	5	0.0	0.0	0	0
717	3	3.5	0.0	0.0	0.0	0	2	9	0.0	0.0	0	0
717	3	2.0	0.0	0.0	0.0	0	10	10	0.0	0.0	0	0
717	3	1.5	0.0	0.0	0.0	0	4	2	0.0	0.0	0	0
717	3	1.0	0.0	0.0	0.0	0	9	1	0.0	0.0	0	0
717	3	0.5	0.0	0.0	0.0	0	10	0	0.0	0.0	0	0

Date	Trsct	Dist	Dico III	Dico IV	Dico V	Dico Pupae	Juga	Litho-glyphus	Small Gloss	Medium Gloss	Large Gloss	Neophylax
717	3	0.0	0.0	0.0	0.0	0	8	0	0.0	0.0	0	0
717	4	0.5	0.0	0.0	0.0	0	6	34	0.0	0.0	0	0
717	4	1.0	0.0	0.0	0.0	0	0	40	0.0	0.0	0	0
717	4	1.5	0.0	0.0	0.0	0	20	29	0.0	0.0	0	0
717	4	2.0	0.0	0.0	0.0	0	61	14	0.0	9.0	0	0
717	4	2.5	0.0	0.0	0.0	0	15	9	0.0	2.0	0	0
717	4	3.0	0.0	0.0	0.0	0	3	0	0.0	1.0	0	0
717	4	3.5	0.0	0.0	0.0	0	0	1	0.0	0.0	0	0
717	4	4.0	0.0	0.0	0.0	0	10	10	0.0	0.0	0	0
717	4	4.5	0.0	0.0	0.0	1	0	5	0.0	0.0	0	0
717	4	4.0	0.0	0.0	0.0	0	17	53	0.0	3.0	0	0
717	4	3.5	0.0	0.0	0.0	0	2	11	7.0	10.0	0	0
717	4	3.0	0.0	0.0	0.0	1	9	9	0.0	62.0	0	0
717	4	2.5	0.0	0.0	0.0	3	3	4	0.0	3.0	0	0
717	4	2.0	0.0	0.0	0.0	0	4	4	0.0	3.0	0	0
717	4	1.5	0.0	0.0	0.0	0	15	9	15.0	0.0	0	0
717	4	1.0	0.0	0.0	0.0	0	18	6	0.0	0.0	0	0
717	4	0.5	0.0	0.0	0.0	0	30	9	0.0	0.0	0	0
717	4	0.0	0.0	0.0	0.0	0	11	7	0.0	0.0	0	0
717	5	0.5	0.0	0.0	0.0	0	5	7	0.0	0.0	0	0
717	5	1.5	0.0	0.0	0.0	0	11	21	0.0	0.0	0	0
717	5	2.0	0.0	0.0	0.0	0	15	27	0.0	0.0	0	0
717	5	2.5	0.0	0.0	0.0	0	2	10	0.0	0.0	0	0
717	5	3.0	0.0	0.0	0.0	1	26	15	0.0	0.0	0	0
717	5	3.5	0.0	0.0	0.0	0	14	14	0.0	0.0	0	0
717	5	4.0	0.0	0.0	0.0	0	12	10	4.0	0.0	0	0
717	5	4.0	0.0	0.0	0.0	0	13	15	0.0	0.0	0	0
717	5	3.5	0.0	0.0	0.0	1	0	10	0.0	0.0	0	0
717	5	3.0	0.0	0.0	0.0	4	19	16	0.0	0.0	0	0
717	5	2.5	0.0	0.0	0.0	0	7	12	0.0	0.0	0	0
717	5	2.0	0.0	0.0	0.0	0	6	9	0.0	0.0	0	0
717	5	1.5	0.0	0.0	0.0	0	22	20	0.0	1.0	0	0
717	5	1.0	0.0	0.0	0.0	16	24	20	0.0	0.0	0	0
717	5	0.5	0.0	0.0	0.0	6	3	38	0.0	0.0	0	0
717	5	0.0	0.0	0.0	0.0	0	3	13	0.0	0.0	0	0